NBS GCR 78-139

An Investigation of Regulatory Barriers to the Re-Use of Existing Buildings

A Team Investigation Conducted by
Massachusetts Institute of Technology
Department of Architecture
N. John Habraken, Head

Prepared for
Building Economics and Regulatory Technology Division
Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

January 1978

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PROJECT SUMMARY

This team investigation focuses on provisions of the regulatory systems which adversely impact re-use of existing buildings. The findings are separated into experientially based team analyses of regulatory systems and data gathered from several Massachusetts sources. A series of recommendations for resolution of specific code problems are made, and a research agenda is presented to identify areas for future study towards the resolution of code-rehab conflicts.

The team's investigation concludes that existing buildings pose a significant problem for code interpretation and enforcement. Problems develop primarily from prescriptive code requirements where technical provisions require identical compliance from both new construction and existing buildings. The team analyzed two articles of the Massachusetts State Building Code and found a number of the technical provisions adversely impacting existing buildings, and often not based on clear technical criteria. While in general code problems are manifest technically, the recommended solutions extend beyond technical change to political, social, educational, and administrative change.

The research agenda, based on team perceptions and collected data, suggest that further investigations in a variety of areas will be necessary before a code can be developed which responds clearly to existing buildings.

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INTRODUCTION

This report on technical barriers to the re-use of existing buildings is the result of a three month team analysis of building regulations and their impact on building rehabilitation. The report is divided into three sections: Team Perceptions, Data, and a Research Agenda. Each section is introduced by a statement of methodology. The research was funded by a grant from the National Bureau of Standards' Center for Building Technology. The applicable building codes of the Commonwealth of Massachusetts were used as a primary reference standard.

TEAM COMPOSITION

The architects and M.I.T. Research Team were chosen by NBS. Code Administrators were chosen by the core team and approved by NBS. The areas of interest and expertise represented by the team included code writing and administration, research methodology, design, engineering, and construction management.

Team Members

Massachusetts Institute of Technology

N. John Habraken, Professor of Architecture
Head, Department of Architecture

Ann M. Beha, Research Associate

Eric Dluhosch, Research Associate

Marilyn Brockman, Ed McFarlan, Susan Schneider
Research Assistants

Perry, Dean, Stahl and Rogers, Inc., Architects and Planners

Frederick A. Stahl

Roger P. Lang

Glen A. Steer

Code Administrators

Paul M. Folkins, Principal Structural and Safety Engineer
Boston Building Department

Norton S. Remmer, Commissioner of Code Inspection
City of Worcester, Massachusetts

Parcipation Framework

Team members collaborated most heavily on Sections I and III: Team Perceptions and Research Agenda. Data and research models were contributed by some team members and compiled by M.I.T. Team members responsibilities included participation in bi-weekly meetings, interviews with the M.I.T. research team, written contributions and completion of worksheets. For Sections I and III the team agreed to consensus positions, and where consensus was not achieved, differing views are presented.

Research Approach

The team was challenged by an investigation where little foundation for research has been laid. Consequently, much of the discussion centered on the philosophical base, and methodology around regulatory processes. Perceptions and experiences are crucial factors in the creation, administration and reform of building codes. The team was assembled as a group of informed technicians and researchers, with broad experiences to be shared. Thus, the research agenda has been developed from the perceptions and consensus of the team members and the limited amount of data collected.

Format

References to data charts or models and keywords are found in the left margin of this Report.

I TEAM PERCEPTIONS

I. TEAM PERCEPTIONS

The investigation of the Code-Rehab relationship identifies two discrete functions: regulatory systems and construction starts for existing buildings. Codes and Rehab must each be explored to identify its inherent characteristics and to determine the range of relationships in the interface between the two functions.

(See Appendix 2)

Worksheets were used to compile team members' perceptions about rehab types, code types and perceived problems. Since technical barriers are the primary concern of the study, the technical interface between codes and existing buildings is most fully explored. However, a number of other relationships were judged equally important by the team, and are described in this section.

While Massachusetts codes were used as a basis of shared experience, this analysis could be extended to other jurisdictions as well. The Massachusetts State Code was adopted in 1975, based on the Basic Building Code promulgated by Building Officials and Code Administrators International, Inc. (BOCA).

TEAM COMPILED DEFINITIONS OF CONSTRUCTION ACTIVITIES IN EXISTING BUILDINGS

The core team was asked to identify a range of construction starts for existing buildings.

The following definitions submitted indicate the breadth, and overlap, of the field:

Preservation

- Involves the application of measures to sustain the existing terrain and vegetative cover of a site, and the existing form, integrity, and material of an object or structure. It includes initial stabilization work, where necessary, as well as ongoing maintenance.[1]

- The application of measures designed to sustain the form and extent of property essentially in its existing state. It aims at halting further deterioration and providing structural safety, but does not include significant reconstruction or restoration of lost historic features. Preservation includes techniques of arresting or retarding the deterioration of a property; or improvement of structural or mechanical conditions to make a property safe, habitable, or otherwise useful without removal of original fabric. All historic property is suitable for preservation.[2]

- The process involving no change, similar to a maintenance process after restoration has transpired.[3]

- The maintenance of the structure in the same physical condition as when it was received by the curatorial agency.[4]

- A program of building conservation which may or may not involve a construction start. Can apply to a total building or parts.[3]

Rehabilitation

- The process of returning a structure to a state of usefulness by repairs or alterations when its significance does not justify full restoration and when its condition or proposed use precludes preservation in its existing form.[4]
- The process of returning a property to a state of efficiency or soundness by repairs or alterations so that it will serve a useful continued or adaptive purpose. Those portions of the property (external, internal, or in combination) which are important to its significance are preserved or restored. A property is not suitable for rehabilitation when such treatment would significantly diminish or destroy the historical or architectural integrity of the project.[2]

Reconstruction

- The process of rebuilding a nonextant structure to its original appearance through archival, architectural and archeological investigation.[4]
- The accurate reproduction of an object or structure, in whole or in part.[1]
- The process of reproducing by new construction the exact form and detail of a vanished building, structure, or object, or a part thereof, as it appeared at a specific period in time. A property is suitable for reconstruction when it is essential to fill a gap in an historic district or scene, and when a contemporary design solution is not acceptable. Reconstruction is an appropriate treatment of an historic resource only when the property to be reconstructed is essential for understanding and interpreting the value of an historic district when no other building or structure with the same association has survived, and sufficient historical documentation exists to insure an exact reproduction of the original.[2]
- Rebuilding a structure with new or used materials.[3]

Replication

- The construction of an exact copy of a still extant building on a site removed from the prototype.[4]

Sources

1. U.S. Department of the Interior, National Park Service.
2. Project Performance Standards, draft of memorandum of agreement between Advisory Council on Historic Preservation and the National Park Service.
3. Team member definition.
4. National Conservation Advisory Council's Subcommittee on Architectural Conservation.
5. Advisory Committee on Historic Buildings, Commonwealth of Massachusetts.
6. General Services Administration.

BUILDING CODE DEFINITIONS OF CONSTRUCTION ACTIVITIES IN EXISTING BUILDINGS

The Massachusetts State Building Code does not acknowledge the range in construction activities previously indicated as criteria for amount or selectivity in code compliance. It alternatively categorizes construction activities in existing buildings in the following manner:

1. Ordinary repairs and normal maintenance
2. Alterations 0 - 25% of physical value
3. Alterations: 25 - 50% of building physical value
4. Alterations: over 50% of building physical value
5. Change of use

M.I.T. RESEARCH TEAM DEFINITIONS

The lack of correlation between these sets of definitions suggests divergent perceptions of construction activity for existing buildings. These four categories are indications of physical changes to a building, which should impact the necessity for code compliance as much as a change in building use.

1. Subtract Elements

2. Subtract Elements and Replace with Same

3. Subtract Elements and Replace with Different

4. Add Elements

Changes of use are not by definition construction starts, and can occur within any one of the four categories.

BASIS FOR COMPLIANCE

In Massachusetts the extent of Code enforcement is based on investment in property. For general maintenance, no compliance is required, for alterations up to 50% of the building's physical value, partial compliance is required. Over 50% investment involves full compliance with the Code standards for the new use.

The team challenged percent of investment as the only basis for code compliance. Investment does not provide an indication of relative safety or hazard, nor can it measure the adequacy of extant systems. (Establishing the investment level can become an administrative decision based on arguments between professionals and investors.) Investment as a basis for compliance discourages large scale capital improvements of deteriorating buildings. Because of the current high construction costs, the cost of routine repair work, such as roof repairs, painting or brick replacement, can quickly add up to a significant proportion of the physical value of a building, thus making the owner responsible for code compliance that (s)he might not be able to afford.

The team felt that if code enforcement were to reflect the code "goals" of health and safety, compliance should be based on a more elaborate criteria of health and safety requirements, economic means of the owner, type and reason of construction activity, rather than the physical value of the building.

Use Change

Use change as a basis for full compliance was challenged by team members. The use of a building does establish some measure of its safety, but a change of use does not always reflect increased risk to health or safety. The team sees levels of health and safety established by a range of building characteristics: use, configuration, building systems and subsystems, construction type, and numbers of occupants.

TEAM RECOMMENDATIONS

Definitions

To aid in determining the level of code compliance a building should respond to, categories of construction activities in existing buildings should be defined. These definitions should rely upon the type of building change (i.e. restoration, renovation, rehabilitation...), the intended use of the building, and the physical additions or subtractions proposed to the building. These definitions should be flexible enough to incorporate changes in the building stock available for re-use (such as buildings currently being constructed).

Compliance

Compliance levels should be based on an appropriate measure of hazards presented to the building occupants. Hazard levels should be based on technical data, type of building use, number of occupants, allowable risks and the previously proposed construction definitions. Investigate more flexible compliance over extended time periods. Establish more extensive and fundamental systems of legal responsibility and regulatory obligations recognizing statutory regulatory powers and professional responsibility.

CODE TYPES

The team identified and rated a range of regulatory processes, which can be considered as generic code types, for impact on existing buildings. Individual perceptions were compiled for team discussion. The following analysis identifies team positions on general code-types and administrative process problems for existing buildings. The code types are presented in order of perceived impact on existing buildings.

CODE TYPE: MASSACHUSETTS STATE BUILDING CODE

PURPOSE AND EXTENT

"To secure public safety, health, and welfare as affected by building construction."[1]

"This system (the code) will consist of the promulgation and maintenance of this statewide, mandatory uniform building code applicable to all buildings and structures; the establishment of a state mechanism for the approval of all new construction materials, devices and techniques; the establishment of a mechanism for state inspection and certification of manufactured buildings, building components and mobile homes; the training and certification of all building code officials; and the coordination of all state agencies having a direct or indirect bearing on this Code through the Technical Code Council whose function is to prevent problems of overlapping jurisdictions and fragmentation of administration."[2]

TEAM COMMENTS

Performance code and prescriptive code: 75% presciptive.

Intended to be self-correcting, i.e.: change with experience, research and technology over time.

PERCEIVED CODE PROBLEMS

1. Code Emphasis

The code, issued in 1975, was written before re-use of existing buildings controlled as much of the construction activity as it does currently. The code addresses extant systems only by exception or within standards intended to be added to design programs.

[1] Commonwealth of Massachusetts State Building Code Commission, State Building Code, 1975, Section 100.3

[2] Commonwealth of Massachusetts State Building Code Commission, State Building Code, 1975, foreword

Example	There are no testing standards or guidelines suggested to support discretionary decisions about extant systems. Code administrators often apply the letter of the law because, beyond the point where the prescriptive regulations cannot address a specific case, the code fails to provide guidance for discretionary judgments.
(Data Chart 4)	In Boston, all exceptions for existing buildings have been sent to the Board of Appeal for the past two years, resulting in red tape and delays.
2. Code Contradictions	Some articles of the code were formulated independently of each other. Many address similar issues and prescribe conflicting solutions. When the supervention of one provision over another is unclear, decisions must be made by appeal if no authority is granted to a local official. Where authority is granted to local official, it is without necessary guidelines.
Example	Many provisions of Article 5 (Light and Ventilation) contradict provisions of the new Article 22 (Energy). The Articles could have been amended together to avoid contradictions and in so doing would have to reconcile the supervention of health standards over, or beneath, energy conservation. Left in their current state, priorities and trade-offs are unclear.
3. Out of Date Standards	Empirical standards are often technically outmoded.
Example	The height of unsprinklered buildings is restricted to 65 feet. This is based on former heights of fire engine ladders but Boston and Springfield ladders, for example, extend to 120 feet.
4. Organization and Reference Standards	The code is not well organized visually or informationally. Many cross references result in confusion for code administrator and code user. Many reference standards are out of print, out of date, and expensive.

MASSACHUSETTS STATE BUILDING CODE

Example	The Springfield Building Department reports that many reference standards are out-of-print, and that the available reference standards cost over $1,000. Small towns may not be able to afford to buy costly and changing reference standards.
5. Performance Versus Prescriptive Standards	Performance standards could be helpful to existing buildings by setting well founded goals, and indicating a variety of ways to achieve them (technical trade-offs). The team assessed the Massachusetts State Building Code as primarily prescriptive, with little flexibility for substitutions or trade-offs. Where the code is performance based, the trade-offs are limited.
6. Codes as a Response	Standards set by the Building Code are often developed as a response to an individual crisis rather than as a result of an on-going research.
Example	The famous Boston Cocoanut Grove nightclub fire in which over 300 persons were killed, resulted in the current position of nightclubs as the highest risk use type, even above high hazard (type A-1), including storage of explosives.
7. Anecdotal Codes	Each code provision has a specific history of development. Many of the provisions are highly anecdotal, not based on wide experience.
Example	Light and ventilation standards were based on cannel coal use and control of communicable disease, particularly diptheria. Our current standards and health problems should be reflected in an updated code.
8. Unspecified Legal Jursidictions	The code does not define the extent of jurisdiction of each type of regulatory official.

MASSACHUSETTS STATE BUILDING CODE

Example

Confusion of the extent of design review or decision authority between Fire Marshall or Building Inspector. These officials often are at odds over interpretation and authority.

ADMINISTRATIVE PROCESSES

The team felt that many Code problems were compounded by the administrative processes for obtaining a Building Permit. The team considered this process particularly difficult and lengthy in cases for existing buildings, since often alterations to existing buildings require variances to the Code.

The Permit Process

Administrative Process	Process Problems
1. Prior approvals submitted to local official.	
2. Submit plans to Building Department and Fire Department in accordance with Section 1200 of State Code.	Conflicts between Building Department and Fire Department jurisdictions. Delays.
3. Review plans and decisions at Building Department and Fire Department.	Guidelines for the compliance review process are lacking (currently assumed but not written).
4. Submit plans and proposals to other appropriate agencies for approval.	There are no published guidelines as to which agencies and at what point in development, should a project be reviewed.
5. Plans approved or refused by local building department; if refused, either revised and resubmitted, appealed, or dropped.	Time delays can result in excessive cost. Time delays for rehab projects may be more costly because the projects often require appeals.
6. Site visits by local inspectors.	This is an opportunity for payoffs, particularly because there may be much interpretation involved in existing building conformance.

	7. Site visits by state inspectors	Retroactive disagreements. Inconsistency of enforcement between state and local inspectors. No case background given to state inspector.

The Appeals Process

	Process	Problems
	1. File appeal: private hearing for aggrieved parties.	Time delay
	2. Review	Although legally there is no precedent set in an appeals case, variances appear to be granted on this basis. It is difficult to project future design decisions based on previous appeal decisions.
	3. Decision	Highly individual interpretations by Appeals Board.

General Process Problems:

The processes for obtaining permits are nowhere clearly spelled out for the applicant.

There are too many areas of expertise (product and system evaluation) for a single individual to understand and administer efficiently (example: Norfolk, Mass. - one man functions as the town building department on a part-time basis).

CODE TYPE - ARCHITECTURAL BARRIERS BOARD RULES AND REGULATIONS - ADOPTED 5-15-77

PURPOSE AND EXTENT	"To provide the physically handicapped full and free use of all buildings and facilities so that they may have the education, employment, living and recreation opportunities necessary to be as self-sufficient as possible and to assume full responsibility as citizens (i.e. together and equal)."[3]
Team Interpretation of Purpose	To make buildings accessible and safe for the handicapped.
Extent	The Architectural Barriers Board rules extend to all places of mercantile use, business, assembly, schools and institutions, parking garages and temporary (including hotels) and multi-family residences (use types C, E, F-1 thru F-7, H-1 and H-2, B, and L-1 and L-2). The rules extend less to industrial buildings (use type D) and do not apply to the storage of high hazard material or one and two family residences (use types A and L-3). The regulation also extends to special buildings identified by the Architectural Barriers Board.
PERCEIVED CODE PROBLEMS	The team recognized the importance of the goals of the Architectural Barriers Board. The following are the preceived difficulties Board rules create for existing buildings.
1. Basis of Compliance	Alterations to buildings which amount to more than 5% of the total assessed value of the building must conform to the regulations. If the cost of the alterations exceed 25% of the building value, the entire building must comply with the regulations.

[3] Commonwealth of Massachusetts, Architectural Barriers Board Rules & Regulations

2. Cost	The established investment level will be the sum of investment over time, not computed annually. The team challenged cost as a basis for compliance, the cost levels set by the ABB (too low) and the methods of computing aggregate investments to establish conformance.
Example	The regulations mandate excessive expenditures (of money, energy, materials) in some cases. The regulations are often satisfied only by elevators for a two story building. This conflicts with the goals of energy conservation standards and takes no account of the size and scope of a building or project budget.
3. Conflicts With Other Codes	Regulations sometimes conflict with other codes.
Example	Regulations for parking garages conflict with Boston fire regulations (FPR4) regarding curb cuts and heights.
4. Accessibility vs. Safety	The code is more concerned with accessibility to the handicapped person without adequate concern about their safety.
Example	Elevators must be installed to allow the handicapped access to all floors of a building but no provisions are made for quick evacuation during a fire when all elevators have stopped.
5. Design Impact	A new building can easily adjust to Code requirements since the physical forms are not yet built and therefore can be designated according to code. However, existing buildings do not have this flexibility, making dimensional conformance much more difficult.

ADMINISTRATIVE PROCESS AND
PROCESS PROBLEMS

	Administrative Process	Process Problems
Approvals by Architectural Barriers Board	Project approval by the Architectural Barriers Board requires submission of the project to the Board for review.	Problems include delay of project, cost uncertainty, and conflicts between the ABB regulations and other codes. Regulatory officials admit that ABB regulations are not uniformly administered in all locations of the state.
Appeals	Request for variance to rules by appearing before Board.	Individual interpretation by Board members, often unpredictable. Board members are politically appointed, not necessarily because of technical expertise.

CODE TYPE - MASSACHUSETTS STATE SANITARY CODE

PURPOSE AND EXTENT

To protect the health, safety and well-being of occupants of housing and of the general public.

This code is included by reference in the Mass. State Building Code. It establishes minimum standards of fitness for human habitation.

In practice this code primarily affects residential units which are not owner-occupied, including residential institutions, rooming houses and hotels. (Use types H_1, H_2, L_1, L_2 and L_3).

PERCEIVED CODE PROBLEMS

This article primarily impacts existing buildings. It specifies requirements for light and ventilation directly dependent and proportional to room dimensions, which was criticized as too prescriptive, without enough trade-offs to accommodate existing buildings.

ADMINISTRATION PROCESS AND PROCESS PROBLEMS

Administrative Process

The code is administered within the same process as Mass. State Building Code. In many jurisdictions, the article is administered by the Health Department. The inspection is generally initiated by complaint, except in areas subject to "systematic inspection" which applies the legal right to inspect all residential uses in a given area.

Process Problems

Significant administrative conflict is created by the separate enforcement of the State Building Code and the State Sanitary Code. Some articles of the State Building Code cover the same issues as the State Sanitary Code (e.g. Light and Ventilation, Article 5). There are conflicts, ambiguities and differing interpretations of similar standards as a result of these redundancies.

CODE TYPE - MASSACHUSETTS STATE PLUMBING CODE

PURPOSE AND EXTENT	To regulate the installation and repair of plumbing systems in the State. Separate and distinct regulation and administration from State Building Code, although the Plumbing Code is incorporated by reference in the State Building Code.
PERCEIVED CODE PROBLEMS	No evaluation standards are set for existing systems.
Limited Acceptance of New Technology	Standards and technologies are limited to systems widely available for construction and does not reflect new developments in plumbing technology.
Example	Waterless toilets, plastic plumbing pipes. Plastic plumbing pipes were only recently allowed by the Plumbing Code. More innovative plumbing technologies such as waterless toilets are not addressed by the code.

ADMINISTRATIVE PROCESS AND PROCESS PROBLEMS

Administration Process	Process Problems
The plumbing code is administered within the same processes as the Mass. State Building Code.	The local building official has no control over the plumbing inspector.
The code is enforced by inspections by the local plumbing inspector.	The Board is politically appointed.
Appeals for variances to this code are made to special Appeals Board consisting of four plumbers and one lawyer.	

CODE TYPE - MASSACHUSETTS ELECTRICAL CODE

PURPOSE AND EXTENT

To regulate the installation and repair of electrical wiring and systems in the State.

Code is incorporated by reference in the State Building code and written as a Fire Protection Regulation (FPR-11).

PERCEIVED CODE PROBLEMS

Criticisms voiced regarding this code were similar to criticisms of the Plumbing Code.

No evaluation standards are set for existing systems.

Accepted standard technologies are limited to systems widely available for current construction and do not encourage or reflect new developments in electrical technology.

ADMINISTRATION PROCESS AND PROCESS PROBLEMS

Administrative Process	Process Problems
Code is administered as part of the Mass. State Building Code, the Fire Prevention Regulations and as a distinct code.	Jurisdictional problems arise between building officials, and Fire Marshal's office, and Electrical Inspectors.
Code enforcement is maintained by regular inspection by local electrical inspectors.	

CODE TYPE - OCCUPATION, SAFETY AND HEALTH ADMINISTRATION REGULATIONS (OSHA)

PURPOSE AND EXTENT

To protect safety and health of building occupants and construction crews.

Applies to all construction during process and new construction design for any use type except owner occupied, single family dwellings.

PERCEIVED CODE PROBLEMS

The format and length of the regulations was criticized. Team members felt the format was unwieldy and poorly referenced and the number of regulations could be reduced.

ADMINISTRATIVE PROCESS AND PROCESS PROBLEMS

Administrative Process	Process Problems
Regular unannounced inspection by OSHA officials.	No appelate discourse - go immediately to courts, which is costly and time-consuming, while work is halted.
Cash fines imposed for violations. All work halted until violation corrected and fine paid.	The fine for non-compliance is often waived (depending on relationship of contractor to inspector). OSHA does not check plans in advance for compliance to these codes.
	Much of code conformance is the responsibility of the contractor whose interests may be divided between the code and economy.

CODE TYPE - FIRE PREVENTION RULES AND REGULATIONS (FPR) (Based on NFPA Guidelines)

PURPOSE AND EXTENT

To specify measures which will provide a reasonable degree of public safety.

To establish proper safeguards against loss of life and property by fire.

Code extends to all construction activity which requires a building permit. Code perceived as 50% specification, 50% performance based.

PERCEIVED CODE PROBLEMS

1. Prescriptive vs. Performance

Team felt that dimensional requirements are excessively restrictive for existing buildings.

2. Trade-offs

No choice in satisfying requirements. Hardware is strictly specified and there are neither hardware/dimensional trade-offs, hardware/hardware trade-offs, or hardware/dimensions/time trade-offs. The team felt that the code's technical base was too undeveloped to accommodate trade-offs. Significant trade-offs can probably not be justified until a more fundamental technical understanding is developed for FPR and existing buildings.

ADMINISTRATIVE PROCESS AND PROCESS PROBLEMS

Administrative Process	Process Problems
The use of NFPA guidelines varies from state to state. In Massachusetts, NFPA regulations are the basis of fire prevention regulations (FPRs) and are administered by the State Fire Marshal's office. In some cases, the approval of the local fire official must be obtained before a building permit will be granted by the Building Department.	

CODE TYPE - FIRE PREVENTION RULES AND REGULATIONS (FPR) (Based on NFPA Guidelines)

	Administrative Process	Process Problems
Permit Process	1. Submit plans to Fire official in accordance with Section 1200.00 of State Code.	1. Redundancy of efforts, overlapping jurisdictions and lack of communication and clear understanding between Building Department and fire official.
	2. Plans approved or rejected by Fire Department. If approved, permit process continues. If rejected, plans must be modified and resubmitted.	

NON-TECHNICAL REGULATORY PROCESSES

The team identified a number of regulatory processes which may impact building re-use more heavily than do building codes. While the team focussed on technically-based regulations, other "soft" regulations are noted below.

ZONING ORDINANCES

Problems

Inflexible zoning provisions may result in either changes of use disallowed or construction types disallowed.

NFPA (National Fire Protection Association Guidelines)

NFPA guidelines are not sensitive to changes needed for adaptive use. Existing buildings may not be able to meet specifications stated in the guidelines, but they might measure well in performance comparisons if criteria were developed for such.

PLANNING BOARD

Problems

Inconsistencies in policy result from political appointments to Board; boards may discriminate against building re-use through their policies.

ACCREDITATION AGENCIES AND REFERENCE STANDARDS

Problems

Standards set for use types to be accredited may discriminate against existing buildings and building systems. Usually these standards do not specify their technical bases, so trade-offs and substitutions cannot easily be introduced.

THE CODE REHAB INTERFACE

The following perceptions and examples were drawn from team worksheets and team discussions, evaluating the relative problems (for existing buildings) lodged in building codes and other regulatory processes in Massachusetts.

Parameters of Code-Rehab Interface

1. Political
2. Social
3. Economic
4. Design
5. Technical
6. Administrative

THE CODE REHAB INTERFACE

Through team discussions of code types and rehab types six parameters to the code-rehab relationship were identified. The team agreed that without solutions made with consideration of a full spectrum of interface problems, solutions of problems created by technical barriers would serve little purpose. Technical parameters were the focus of this study, however, and the team further analyzed two articles of the Mass. State Building Code to identify a range of current technical problems. (See Case Studies.) In addition, perceptions about the five other parameters to the Code-Rehab relationship -- political, social, economic, administrative, and design are presented.

1. POLITICAL

The team perceived codes as part of the political process. Politics impact on several levels.

Appointments — Control of leadership development and administration through political appointments.

Budgeting — Control of research and development efforts through funding.

Incentives — Influence on the growth of the rehab sector through tax policy development incentives.

Recommendations

Appointments	The team urges the development of clear criteria and professional appointment policies. Proper recognition of the role and responsibilities of building officials would encourage capable judgments on code decisions.
Budgets	Funding for the regulatory processes to insure that technical goals and standards are updated and implemented should be increased.
Incentives	Compliance incentives should be provided so that code standards reach the unregulated sector. Incentives might include partial compliance levels, tax deductions for compliance costs, etc. The team recognizes the existence of a very large unregulated sector which operates outside the codes for a variety of economic and social reasons, with a resulting lowered standard of life and property safety. The team feels that the codes should recognize social options and social values.
2. SOCIAL	The team saw social values and social goals as the foundation of regulatory systems.
Values	Do current regulatory standards reflect societal goals? Are code standards publicly supported or publicly understood?
Home Rule	Should a community be able to set its' own standards for life and property safety, as they do with zoning, town and city regulations?
Neighborhoods/Residential Markets	Can code compliance result in disenfranchisement of residential population? Can low-income neighborhoods afford compliance?
Recommendations	These fundamental issues mandate further study.

3. ECONOMIC

The team recognized a clear cost-benefit question in the application of building codes to new or existing buildings.

Data Base Needed

The comparison of cost for compliance between new and existing buildings could only be conjectured as time was too short to generate data on relative costs. Both exercises of cost-benefit and cost comparisons would be useful in determining the comparative degree of hardship or cost imposed by code conformance.

The team, while recognizing the economic implications of codes for existing buildings, also recognized the economic influences which have produced codes:

Insurance

The insurance industry has played an influential role in setting life and property safety standards and values. Insurance is based on recognizing and underwriting risk.

Banking

The banking industry has influenced the rehabilitation sector by controlling funds available for rehab. The cost of code compliance is assumed as part of a general rehab cost and carried in the financing costs of a project. The financial strategies of banking and insurance will impact code standards and rehab starts. Any proposed revisions to codes affecting life, property safety or size and scope of rehab starts probably could not be effectively developed or implemented without responding to banking concerns and policies and insurance.

Recommendations

A clear identification of the interests and roles of financial institutions in code promulgation would be essential to code modification.

A cost benefit analysis of code compliance would reveal the extent of economic burdens that code compliance imposes. Theoretic models could be developed for alternate compliance systems to alleviate unnecessary or unexpected costs related to code conformance in buildings with extant systems.

4. ADMINISTRATIVE

The team perceived that much of the difficulty of code applications for existing buildings is lodged in the administrative structure of building departments, code authorities, and personnel. To solve any code-rehab problems, this administrative structure must be addressed. Specific administrative problems include:

Responsibility

Since existing buildings don't fit neatly into the building code provisions local officials resort to exceptions, appeals or conformance. Exceptions, i.e. independent decisions by the building official, mean that the official must take responsibility for the decision. When life or property safety is at issue, many officials are unwilling to make these decisions, particularly where the codes offer no guidelines. An unnecessarily large number of applicants must, therefore, request variances to code provisions by submitting an Appeal, a time consuming process. Possibly a large number of projects are dropped as a result of this bureaucratic process.

Code Bureaucracy

Team members felt that complicated organizational solutions to Code administration have resulted in more delays, confusion and cost, and that we now must cope with a dramatically inflated code bureaucracy, which has little incentive for simplification.

Overlapping Jurisdictions

As can be seen in the analysis of code types, conflicting and overlapping jurisdictions are a serious problem. Both administrator and owner are hindered by such confusions of authority.

Communication

New codes and amendments are not widely disseminated. Updated technical information is difficult to incorporate into the codes. Many reference standards are unavailable and outdated.

Recommendations

The team suggests the following recommendations to clarify the role of the code official:

Establish basic guidelines for code officials that translate technical standards for cases involving existing buildings.

Clarify jurisdictions between code authorities.

Examine the role and qualifications of building officials and establish an appropriately qualified pool of building officials to handle the problems posed by existing buildings.

Generate clear compliance and administrative guidelines for code-users.

5. DESIGN

Since existing buildings by their nature offer extant configurations, structural systems and sub-systems, design adaptation for code conformance should address both a given program and a proposed program. The present codes do not address extant programs.

Codes impose limitations on design for all building types. The particular design concern for existing buildings is that too often esthetically valuable and fuctionally efficient building elements must be replaced with elements that fit the letter of the code.

Recommendations

Design issues will be resolved by the expansion of allowable technical alternatives.

6. TECHNICAL

Technical problems lodged within the Code were perceived within four basic areas:

1. Assumption that all buildings within a given use group should share the same safety levels, or accessibility, to same degree and standards.

2. Absence of effective criteria for evaluation of an existing building's levels of risk/safety.

3. Lack of relationship of compliance to issues like building configuration, structure and subsystems, use, or occupancy level.

4. Lack of range of choice in technical compliance options.

More generally, the team felt that most codes lack a clearly determined and stated technical base. Some codes were criticized as anachronistic, others as the result of combined interests of industry, insurance, and regulatory groups. But the superceding concern is with the basis of the codes: Are they current, well-researched and technically justified? The absence of clear technical goals and standards makes existing buildings particularly problematic, for there can be no alternative systems or evaluations if the standards are not indicated.

Language and Format

The team thought that the technical language of the Code was loose and somewhat artificial. There is a lack of consistency in implied technical standards, and no clear relationships between classifications and objectives or criteria.

Recommendations

Each code type should make available a range of technical compliance options. Technical and hardware trade-offs are only a part of this choice system. Prescriptive (specification) codes are particular obstacles to design but helpful in many ways to administrative processes. A code which enables rehab must recognize broad variation in building types; prescriptive codes do not. Code tradeoffs should relate both to the concerns of administration and to the buildings administered but they should be technically well-founded. A long range solution involves redefining the purpose (and jurisdictions) of different codes, and determining where existing buildings can comply with these standards. Policy for existing buildings can be made only when there is clear agreement on the hazard posed by such structures relative to the hazards posed by new construction for the same use types. The basis for compliance should be all the extant

information, not simply the investment or use type. Testing and technical evaluation are essential to the development of sound technical information about existing buildings.

The short term solution would rely on minor provision changes to accommodate existing buildings such as the BOCA "Code Enforcement Guidelines for Residential Rehabilitation (1975)". The team finds this solution unsatisfactory, and suggests that there are few short term solutions to solve technical problems without fundamental research, or compilation of existing information to formulate updated standards.

CODE TEXT: MASSACHUSETTS STATE BUILDING CODE - ARTICLE 5 - LIGHT AND VENTILATION

SECTION 501.0 DEFINITIONS

HABITABLE ROOM, MINIMUM HEIGHT: a clear height from finished floor to finished ceiling of not less than seven and one-half (7 1/2) feet, except that in attics and top half-stories the height shall be not less than seven and one-third (7 1/3) feet over not less than one-third (1/3) the area of the floor when used for sleeping, study or similar activity.

SECTION 503.0 STANDARDS OF NATURAL LIGHT

503.4 STAIRWAYS AND EXITWAYS IN RESIDENTIAL AND INSTITUTIONAL BUILDINGS

503.41 WINDOWS:

In all multi-family dwellings (use group L-2) and in institutional buildings for the care or treatment of people (use group H-2) required interior stairways shall be provided with windows to the outer air having a glass area of not less than ten (10) square feet which opens on a required street, alley, yard or court, or with the equivalent source of light for each story through which the stairway passes; and such additional artificial lighting to provide the equivalent illumination at all times that the building is occupied as specified in Section 624.0.

CASE STUDIES: TWO ARTICLES OF THE MASSACHUSETTS STATE BUILDING CODE

The team saw the technical aspects of the Code-Rehab interface as the focus of its study. To specify a range of technical problems, the team examined two articles of the Massachusetts State Building Code, Light and Ventilation (Article 5) and Means of Egress (Article 6).

Each team member cited to the team provisions in the Articles which create unnecessary problems in building re-use. The team analyzed the severity of each problem and discussed possible solutions for the problems.

MASSACHUSETTS STATE BUILDING CODE - ARTICLE 5 - LIGHT AND VENTILATION: PERCEIVED PROBLEMS

501.0 DEFINITIONS

Specific Dimensional Requirement

The code specifies a clear ceiling height in habitable rooms 7 1/2 feet except in attics which shall not be less that 7 1/3 feet. The team suggested a change of allowable minimum height for habitable rooms to 7 feet. The team also suggested clarifying the issue of protrusions from the ceiling (such as dropped beams) and the allowable clear height beneath the protrusions.

503.0 STANDARDS OF NATURAL LIGHT

503.41: WINDOWS

503.43: HALLWAYS

The team felt that the standards of natural light and natural ventilation were based on antiquated minimum health standards. The numbers seem somewhat arbitrary.

504.0 STANDARDS OF NATURAL VENTILATION

504.1 AREA OF NATURAL VENTILATION OPENINGS

There appear to be two classifications of code requirements for these articles:

503.43 HALLWAYS: Hallways shall have at least one window opening directly on a street or on a required yard or court in each story, located so that light penetrates the full length of the hallway, with additional windows for each change of direction of the hallway; or the equivalent artificial lighting shall be provided. Every recess or return with a depth or length which exceeds twice the width of the hall, and every corridor separately shut off by a door, shall be treated as a separate hall in applying the provisions of this section.

SECTION 504.0 STANDARDS OF NATURAL VENTILATION

504.1 AREA OF NATURAL VENTILATING OPENINGS: Natural ventilating openings from habitable spaces shall have a free area when open of at least five percent of the floor area of the space ventilated....

504.2 VENTING OF SPECIAL SPACES

504.21 ALCOVE ROOMS: When alcove rooms open without obstruction into adjoining rooms, the required window openings to the outer air shall be based on the combined floor area of room and alcove. No such alcove space shall be more than sixty (60) square feet in area and the opening to the adjoining room shall be not less than eighty (80) percent of the superficial area of the dividing wall, unless provided with separate means of light and ventilation.

SECTION 505.0 VENTILATION OF INSTITUTIONAL BUILDINGS FOR FORCED DETENTION: In buildings of the Institutional use group used for enforced detention, all rooms shall comply with the requirements of the article for light and ventilation. However, where necessary, alternate means of complying with these provisions may be approved, providing that it can be shown that they fulfill all the requirements of these provisions for light and ventilation as applicable.

504.2 VENTING OF SPECIAL SPACES

504.21 ALCOVE ROOMS

1) Requirements for personal health:
The 10% openings requirements for light and 5% openings requirements for ventilations seem to have more connection with psychological well-being than physical health. The determination of these figues is not discernable as researched facts.

2) Life safety requirements:
Minimum levels of light and ventilation should be established for egress ways. Present 10% and 5% figures seem convenient; not recognized as determined minimums.

505.0 VENTILATION OF INSTITUTIONAL BUILDINGS FOR FORCED DETENTION

This standard is an example of Code-implied social values; i.e. treating jails in a more flexible way than other occupancy types. In addition, it is an example of a weak performance code which develops no compliance trade-offs.

SECTION 508.0 STANDARDS OF MECHANICAL VENTILATION

508.22 CURVE A - VENTILATION ONLY: The values obtained from Curve A in Figure 5-1 represent the minimum volume of outside air required for adults quietly occupied. Where the space has mechanical cooling, the values of Curve represent the minimum amount of air to be circulated.

a) Values of Curve A shall be increased by twenty-five (25) percent for areas in which the occupancies contain or involve:

 1) Grade school children
 2) Light smoking
 3) Food Service
 4) Other occupancies involving air contamination

b) Values of Curve A shall be increased fifty (50) percent for areas in which the occupancies contain or involve:

 1) Manual labor
 2) Sports
 3) Dancing
 4) Heavy smoking
 5) Other occupancies involving heavy air contamination

c) Values of Curve A shall be increased by an appropriate amount to remove excess heat or moisture generated by equipment in the occupied area.

508.0 STANDARDS OF MECHANICAL VENTILATION

Determining Mechanical Requirements by Occupancy Types Alone

Minimum values for outside air requirements for ventilation and air conditioning in Figure 5-1 (Section 508.21, explained in Section 508.22 and 508.23) increase for occupancies involving children, heavy physical activity, smoking or other air contamination. The team felt that the density or scale of the occupancy should also impact minimum values.

Example

A restaurant for twenty people should not have the same ventilation requirements as a restaurant for 150 people.

A possible solution would be to determine curves in Figure 5-1 to represent allowable room volume in cubic feet per person based on legal capacity.

MASSACHUSETTS STATE BUILDING CODE - ARTICLE 5 - LIGHT AND VENTILATION

PERCEIVED GENERAL PROBLEMS AND SUMMARY RECOMMENDATIONS

Historically Based Standards	Article 5 of the Building Code, controlling light and ventilation, was derived from provisions originally governing gas lights, and burning of coal in fireplaces. The article originated as a health standard to deal with the serious noxious vapors and problems of transmission of disease. Most standards in the article are historical artifacts of these concerns.
Technical Problems: Short Term Solution	A short term solution of problems cited in the previous discussion of Sections in Article 5 is to broaden the range of acceptable specifications and hardware to be used to satisfy the provisions of the Code. In addition, trade-offs between artificial and natural light or ventilation should be incorporated from existing data. Article 5 should also be revised to reflect energy conservation requirements established in the energy amendment (Article 22 of the Mass. State Building Code).
Objectives for Article 5	By clarifying the objectives of the article the team was able to establish recommendations for revisions to Article 5. In the team's opinion, the major objective of Article 5 should be to state requirements for light and ventilation in terms of minimum standards that would relate aggregated performance of natural light and ventilation and artificial light and ventilation for any occupancy load, use type and location.

Long Term Recommendations

Issues that should be included in a revised Article would establish:

1) Minimum levels of "natural" light required

2) Minimum levels of "outside" air required

3) Minimum levels of aggregated light required

4) Minimum levels of aggregated ventilation required

5) Maximum levels of energy consumption related to providing artificial means to meet minimum standards for aggregated levels of light and ventilation.

6) Separate performance requirements where necessary for fire-related ventilation.

7) A methodology for building officials to determine acceptable variations for light and ventilation requirements based on particularities of a building's occupancy load, use type and location.

To establish these minimum levels, specific equivalency standards between natural and artificial light and ventilation must be developed.

Minimum levels of light and ventilation for physiological and psychological comfort under different conditions of occupancy and type of activity should be compared to develop criteria for establishing new standards. The team felt that by knowledgeable incorporation of criteria allowing the possibilities for change and adaptability of human environments the code could become a considerable aid in the control of the quality of an environment as well as a minimum health standard. Therefore, as a research agenda, Light and Ventilation should be updated to recognize health, psychological and physiological comfort, and energy as rational bases of technical provisions.

MASSACHUSETTS STATE BUILDING CODE - ARTICLE 6 - MEANS OF EGRESS: CODE TEXT

SECTION 603.0 USE AND OCCUPANCY REQUIREMENTS

603.4 BUILDING ACCESS FOR HANDICAPPED:

All buildings and parts thereof classified in use groups C (Mercantile), D (Industrial), E (Business), F (Assembly), H (Institutional), L-] and L-2 (Residential) shall have at least one primary entrance accessible to and usable by the handicapped. Such entrance shall provide access to a level that makes elevators available in buildings where elevators are provided...

SECTION 607.0 TYPES AND LOCATION OF EXITWAYS

607.3 LENGTH OF TRAVEL:

... [I]n buildings of residential, mercantile or institutional use groups where the area is subdivided into rooms or compartments, and the egress travel in the room or compartment is not greater than fifty (50)* feet, the distance shall be measured from the exitway access entrance to the nearest exitway.

*May be increased to 100 feet, in use groups equipped with automatic sprinklers.

SECTION 608.0 CAPACITY OF EXITS

608.1 UNIT OF EXIT WIDTH:

The basic whole unit of clear exit width is twenty-two (22) inches and its whole multiples. The allowance for excess width of twelve (12) inches to twenty-one (21) inches is one-half (1/2) unit. (No credit given for excess width less than twelve (12) inches.)

MASSACHUSETTS STATE BUILDING CODE - ARTICLE 6 - MEANS OF EGRESS: PERCEIVED PROBLEMS

SECTION 603.0 USE AND OCCUPANCY REQUIREMENTS

603.4 BUILDING ACCESS FOR HANDICAPPED

Jurisdictional Overlaps	This section creates problems similar to the Architectural Barriers Board Rules. The appeals process for this section is complicated: a waiver must be granted by the Architectural Barriers Board as well as a variance permitted by the State Board of Appeals.

SECTION 607.0 TYPES AND LOCATION OF EXITWAYS

607.3 LENGTH OF TRAVEL

Limited Technical Tradeoffs to Satisfy Compliance	This section allows an increase in the length of travel to an exitway when a "fire supression system" is used. The team thought that an early warning system would also provide adequate protection to allow a similar increase in length of travel.

SECTION 608.0 CAPACITY OF EXITS

608.1 UNIT OF EXIT WIDTH

Specific Dimensional Requirement	The team thought this section arbitrarily prescriptive. Exit widths should be based on tested data for number of people using exitway, allowable time for exiting, necessary entrance requirements for fire equipment and other related variables.

SECTION 609.0 NUMBER OF EXITWAYS

609.11 EXITWAYS IN RESIDENTIAL GROUPS:

In all multi-family residential use groups (L-2), except as provided in Section 609.12, each apartment shall have access to at least two (2) independent exits which are remote from each other; such exits shall be so arranged that to reach either exit it will not be necessary to pass through a public corridor which serves the other.

609.12 EXITWAYS IN L-2 USE GROUP FOR TYPES 1-A, 1-B, 2-A AND 2-B CONSTRUCTION:

In buildings of types 1-A, 1-B, 2-A and 2-B construction, a single exitway shall be permitted for every room, or group of less than four (4) rooms used for residential occupancy on multi-family floors, provided that elevator lobbies on all floors except the ground floor, are enclosed with self-closing smoke doors and partitions...

SECTION 610.0 EXITWAY ACCESS PASSAGE-WAYS AND CORRIDORS

610.31 HEIGHT:

A clear height of seven (7) feet six (6) inches shall be provided for at least seventy-five (75) percent of the floor area of the exitway corridors with no point less than seven (7) feet in height...

SECTION 609.0 NUMBER OF EXITWAYS

Technical Base Limited

The team thought alternative methods of solving numbers of exitways and their dimensions should be considered for existing buildings. Possible alternatives would consider the combinations and distribution of exitways throughout the building.

609.11 + 609.12

EXITWAYS IN RESIDENTIAL USE GROUPS

Alternate Compliance

Many existing buildings comply to old Boston City Code which allowed residential egress via doors to a common corridor having access to two remote means of egress. The team agreed that the provision in the old Boston Code is more sensible than the current provisions in Section 609.11, but there is no technical base on which to evaluate its effectiveness.

SECTION 610.0 EXITWAY ACCESS PASSAGEWAYS AND CORRIDORS

610.31 HEIGHT IN EXITWAY ACCESS

Specific Dimensional Requirements

Many existing buildings have spaces with a clear height of less than the 7'6" required in this section. There are not tradeoffs or alternatives to make these spaces usable.

TABLE 6-6: MINIMUM STANDARDS FOR STAIRWAY AND ENCLOSURE CONSTRUCTION

SECTION 616.0 INTERIOR EXITWAY STAIRWAYS

616.21 WIDTH:	All required interior stairways shall be at least forty-two (42) inches in width except that such width may be reduced to thirty-six (36) inches in buildings of use group L-3 (one and two-family dwellings) or in exitways from boiler rooms and similar service spaces...
616.32 VERTICAL RISE:	In buildings of use group F (assembly) and use group H (institutional) occupancy, the height of vertical rise shall not exceed eight (8) feet between landings and intermediate platforms. In all other buildings, no stairway shall have a height or rise of more than fifteen (15) risers between landings, nor shall any single stairway have less than three (3) risers.

TABLE 6-6: MINIMUM STANDARDS FOR STAIRWAY AND ENCLOSURE CONSTRUCTION

Limited Compliance Alternatives	The table should be revised to include requirements for sprinklers and early warning systems.
SECTION 616.0 INTERIOR EXITWAY STAIRWAYS	
616.21 WIDTH	
Specific Dimensional Requirements	Specified width of stair may not be available in an existing building. The team suggests allowing variable widths whose capacity is determined by the use of 608.2 (Design Capacity Allowances) and other emergency data regarding stair.
616.32 VERTICAL RISE	
Specific Dimensional Requirements	Since some pre-code buildings have tall floor to floor heights, the team felt that increasing the permitted maximum of risers from 15 to 20 would greatly ease compliance for existing buildings. Also as minimum requirement of 2 risers for existing stairs would increase ease in compliance.

616.4 TREADS AND RISERS

616.41 MINIMUM DIMENSIONS: The height of risers and the width of treads in inches shall be as follows:

Use Group	Maximum Risers	Minimum Tread
One and two-family dwellings (Use Group L-3)		
All stairs with closed risers	8 1/4 inches	9 inches
Stairs with open risers	8 1/4 inches	9 inches
Assembly and institutional	7 1/2 inches	10 inches
All others	8 inches	9 inches

616.5 STAIRWAY GUARDS AND HANDRAILS: Unless otherwise [specified] ... all stairways ... shall have continous guards and handrails on both sides, and in addition thereto, stairways required to be more than eighty-eight (88) inches in width shall have intermediate handrails dividing the stairway into portions not more than eighty-eight (88) inches wide.

616.6 STAIR EXITWAY DOORS

616.62 DIRECTION OF SWING: All doors shall swing on a landing in the direction of exitway travel. When open, stair exitway doors shall not reduce the width of landings to less than the minimum required for its capacity and in no case to less than thirty-six (36) inches.

616.4 TREADS AND RISERS

616.41 MINIMUM DIMENSIONS:

Specific Dimensional Requirements	Careful study must be made to ascertain the effect of this section on existing stairs.

616.5 STAIRWAY GUARDS AND HANDRAILS

Specific Dimensional Requirements	The team felt that rails should relate to the width of the stair and the type of person using the stair (example: elderly person would have definite handrail and stairway guard preferences) rather than a pre-prescribed dimension.

616.6 STAIR EXITWAY DOORS

616.62 DIRECTION OF SWING

Specific Dimensional Requirements	Dimensions and configurations suggested by this section are not sensitive to many configurations presently existing in buildings. Technical alternatives should be presented for existing buildings that cannot meet requirements of clear dimensions with doors swinging in direction of exitway travel.

616.8 SUPPLEMENTAL STAIRWAYS: Monumental, ornamental, or accessory stairways shall not be allowed without required enclosures in use groups D (Industrial), F (Assembly), and H (Institutional), and structures of type 3B, 3C, 4A, and 4B construction, unless specifically allowed in Section 416.22. In all other structures, monumental, ornamental or accessory stairways extending from the grade floor to the basement or to the second floor, when not required as an element of exitway and not connecting more than two (2) adjoining stories, shall be allowed without enclosures. Monumental, ornamental or accessory stairways shall be additional to and shall not obstruct or interfere with required exitways.

616.9 STAIRWAY CONSTRUCTION: Unless herein otherwise provided, all required interior stairways shall be built entirely of noncombustible materials with solid risers, treads and landing platforms and all finish floor surfaces on non-slip noncombustible materials; except that wood handrails shall be permitted, complying with the requirements of section 616.5. In one and two-family dwellings, open risers may be used.

SECTION 617.0 ACCESS TO ROOF

617.1 BY STAIRWAY: In buildings four (4) stories or more in height with roofs having a slope of less than twenty (20) degrees, access to the roof shall be provided by means of a stairway...

SECTION 618.0 SMOKEPROOF STAIRWAY ENCLOSURE

618.1 WHERE REQUIRED: At least one (1) of the required exitways shall be a smokeproof stairway enclosure in buildings over five (5) stories or over seventy (70) feet in height when one (1) of the following use groups: ...

618.8 SUPPLEMENTAL STAIRWAYS

No compliance alternatives to retain special features of existing buildings	Monumental and ornamental stairs are often the most beautiful asset of an existing building. This section states that they must be enclosed or that they may only run from the basement level to the second floor, depending on the use of the building. The team felt that this section should consider fire suppression systems to tradeoff with enclosure to allow existing monumental stairs to remain in their original state.

616.9 STAIRWAY CONSTRUCTION

Arbitrary Limitations	The team could not determine why the use of open risers was limited to one and two-family residences.

SECTION 617.0 ACCESS TO ROOF

617.1 BY STAIRWAY

Limited Compliance Alternatives	Provisions for roof access should allow the use of hatch or scuttle access and ship ladders in lieu of stairs in existing buildings.

SECTION 618.0 SMOKEPROOF STAIRWAY ENCLOSURE

618.1 WHERE REQUIRED

Limited Compliance Alternatives	The reference to number of stories of a building as criteria for exitways works against certain types of existing buildings with shallow floor to floor dimensions.

618.83 STAIRSHAFT VENTILATION: The stairshaft shall be provided with emergency mechanical supply and exhaust air. There shall be a minimum of one (1) air change per minute. The supply shall be sufficient to provide a minimum of 0.05 inches of water column pressure (0.00185 pounds per square inch) above ambient with all doors closed.

SECTION 619.0 EXTERIOR EXITWAY STAIRWAYS

619.1 AS REQUIRED EXITWAY: Exterior stairways conforming to the requirements for interior stairways in all respects, except as to enclosures and except as herein specifically modified, may be accepted as an element of a required means of egress in buildings not exceeding five (5) stories or sixty-five (65) feet in height for other than use group H (institutional) provided there is at least one (1) additional stairway.

SECTION 621.0 FIRE ESCAPES (Problem issue is not addressed in the code text.)

618.83 STAIRSHAFT VENTILATION

Limiting Dimension

The team thought that the air change requirements seemed unreasonable since it requires massive equipment sizes which waste energy and are expensive. However, the issue should be studied by competent HVAC Engineers to determine actual minimum air-change rates to maintain positive pressure in stairshafts.

SECTION 619.0 EXTERIOR EXITWAY STAIRWAYS

619.1 AS REQUIRED EXITWAY

Limiting Dimension

The height limitation for exterior stairs (not to exceed 65 feet) seems unnecessary since presumably they are as safely designed as interior stairs.

SECTION 621.0 FIRE ESCAPES

Unaddressed Issue

Connecting balconies, a troublesome issue for renovators and historic building commissions, are not confronted in the codes. The team suggests that connecting balconies be allowed built to acceptable standards in instances where fire escapes are permitted if exitway allows occupant to transfer to an alternate fire zone.

MASSACHUSETTS STATE BUILDING CODE - ARTICLE 6 - MEANS OF EGRESS

PERCEIVED GENERAL PROBLEMS AND SUMMARY RECOMMENDATIONS

Limited Field Testing
(Data Charts 2, 6, and 12)

Of all articles of the code, the egress provisions create the most numerous and significant technical obstacles to building re-use

The egress provisions are the products of many influences, including the code sector, firefighters and NFPA. The technical base for egress was significantly influenced by field test for access to buildings by firefighters. Prescriptive widths and numbers for egress capacity incorporated the results of limited field testing. Current egress standards do not yet reflect accurately testing data on such issues as length of time to travel, normal egress patterns or human behavior under alarm stress.

Unestablished Evaluation Methods For Existing Egress

While existing buildings were built to codes with legal requirements for egress, there are no article provisions providing evaluation methods for establishing the safety of stairs of differing widths, lengths or configurations, except to disallow certain types. Equivalencies of egress are not established: (i.e. when do two small staircases equal one "new code" egress?). The widths and lengths prescribed do not necessarily relate to occupancy characteristics or in some cases to use types.

Confusion of Life and Property Safety

The team felt that compliance standards for life safety and property safety were arbitrarily combined in the code and did not incorporate technical and experience-based differentiation. The team stressed the need to be able to isolate these issues for evaluation purposes.

Short Term Solutions

There are few short term solutions for egress. The problems of egress are significant and while there is some data available, much must be gathered as part of a long range agenda. The team suggests a short term solution of gathering existing relevant information for code officials so that discretionary administrative decisions are well-founded.

Long Term Solutions

The necessary research for prescription of life safety and egress standards should relate data on incidence of injury and life loss in existing buildings with construction type, configuration, occupancy characteristics, use types, available egress, early warning systems and human behavior. While the mechanisms for monitoring fires are available through NFPA, the data for existing buildings has not been compiled except for residential use types (L-1, L-2, and L-3). Allowances or tradeoffs in the code must be based on compiled data rather than assumptions or reactions to crises.

Much of the issue of life safety and survival relates to time. Standard early warning systems could be prescriptive, if data-based, but hardware and dimensions for compliance should be performance-based. Allowable conformance trade-offs should relate directly to performance standards.

II DATA

II. DATA

Data Base

Data collection for this study was a function not only of time and budget, but also of accessibility of resources. Data drawn retroactively cannot measure or investigate unrecorded activities and concerns. The team chose to focus on two accessible data bases: Boston, Massachusetts (pop. 641,071) and Springfield, Massachusetts (pop. 163,905). Some statewide data was made available through the cooperation of the Building Reuse Project of the Massachusetts Department of Community Affairs. Retroactive data compilation in this field is difficult because data is often incomplete and often did not answer team questions. The M.I.T. research team, in analyzing this limited data base, is aware of its interpretive limitation. Thus, each chart is accompanied by a discussion of its source, interpretive assets, and liabilities.

Administrative Profiles

Three administrative profiles are presented to elaborate on operational modes and decision-making within the code inforcement sector. Two profiles describe individual Massachusetts cities, and are based on a series of interviews with Code administrators. The third profile interprets a State-wide administrative guideline sheet to show how decisions are made by local code inspectors.

Data Base : STATE OF MASSACHUSETTS

SOURCE: Data in the following two graphs (pages 61 and 62) was compiled from appeals made to the Massachusetts State Board of Appeals through Draft Data from the Building Reuse Study of the Massachusetts Department of Community Affairs.

TIME PERIOD: Data covers variances granted from January 1975 through January 1977.

NOTES: Data was formulated from appeals made on behalf of existing buildings only.

The data on statewide appeals is not complete. It covers appeals that were made directly to the State Board of Appeals and does not include appeals made to local boards in Massachusetts cities.

Notes on each page indicate references and significant points of the graphs.

CONTENTS:

Data Chart 1: Statewide Appeals to the Massachusetts State Building Code by Code Article (For Existing Buildings)

Data Chart 2: Statewide Appeals to the Massachusetts State Building Code by Sections of Article 6 (For Existing Buildings)

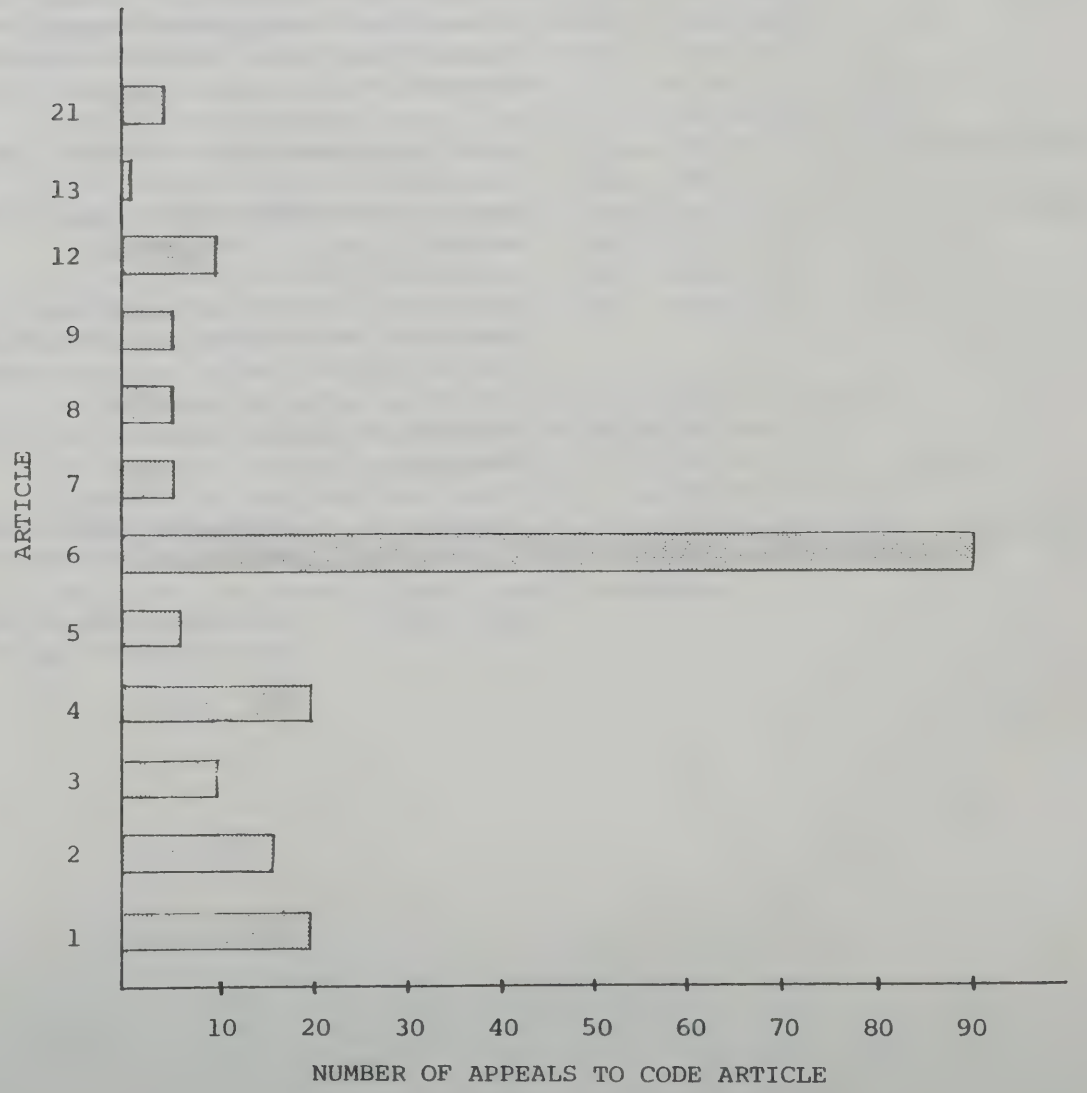
STATEWIDE APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE BY CODE ARTICLE (FOR EXISTING BUILDINGS)
Data Chart 1

NOTES:

1) Appeals to Article 6 constitute 47% of the total appeals in this sample.

2) Article 5, which the team perceived as a significant technical barrier to building reuse, constituted only 3% of the appeals sampled. However, this article relates to many abstract and technically based design concepts which are only quantifiable by review of engineering computations. Consequently the evaluation of code compliance to Article 5 is a difficult and time consuming process. A Building Code Official is not in the position to make such an evaluation and will frequently accept what is presented in an application.

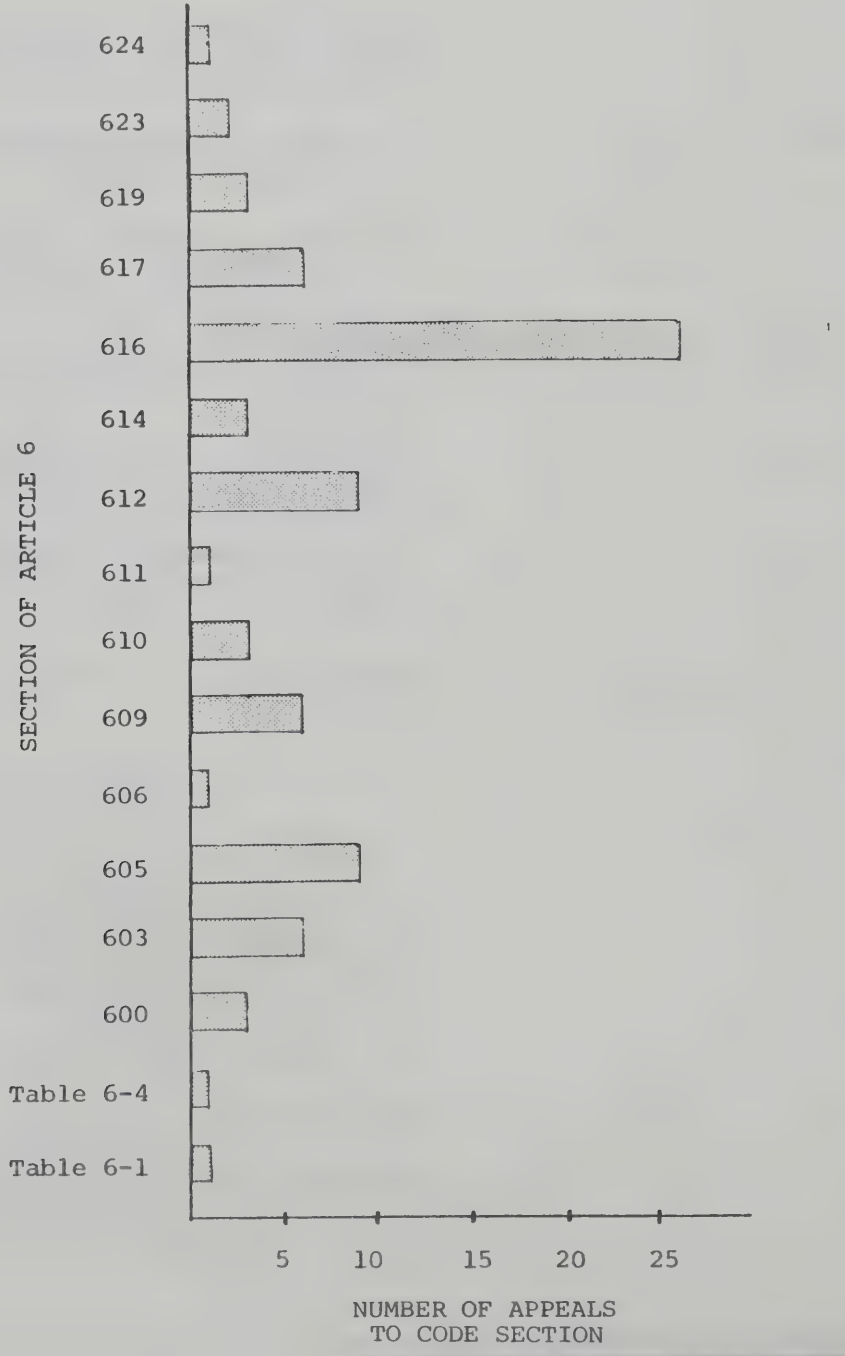
(See page 60 for information on data; page 77 for article titles.)



STATEWIDE APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE BY SECTIONS OF ARTICLE 6 (FOR EXISTING BUILDINGS)
Data Chart 2

NOTES:

Appeals to Section 616 (Interior Exitway Stairways) constituted 26% of the total appeals to Article 6. Refer to team discussion of Article 6 in Section I.



(See page 60 for information on data; page 79 for section titles.)

Data Base : BOSTON, MASS.

SOURCE:

The following four graphs (pages 64, 65, 66, and 67) evaluate appeals made to the City of Boston Board of Appeals. The source of the remaining graphs is referenced on the page of the graph.

TIME PERIOD:

Data for these four graphs covers variances granted from January 1975 through July 1977.

NOTES:

The data is complete, based on examination of all recorded appeals for building alterations to the City of Boston Board of Appeals for the time period.

Data was formulated from appeals made on behalf of existing buildings only.

All requests for variances to the State Building Code in Boston were granted by the Boston Board of Appeals during this time period.

There were forty (40) appeals cases for existing buildings during this time period all of which requested variances to more than one section of the code.

Notes on each page indicate references and significant points of the graphs.

CONTENTS:

Data Chart 3: Appeals to the Massachusetts State Building Code in Boston, Mass. by Use Type (For Existing Buildings)

Data Chart 4: Time For the Appeals Process at the Boston Board of Appeals

Data Chart 5: Appeals to the Massachusetts State Building Code in Boston, Mass. by Code Article (For Existing Buildings)

Data Chart 6: Appeals to the Massachusetts State Building Code in Boston, Mass. by Sections of Article 6 (For Existing Buildings)

Data Chart 7: Boston Building Department Operations: Permits and Dollar Value of New Construction and Alterations

Data Chart 7a: Total Dollar Investment Value of New Construction Compared with Alterations in Boston, Mass.

Data Chart 7b: Alterations in Existing Buildings in Boston, Mass. As a Percentage of Total Construction Value

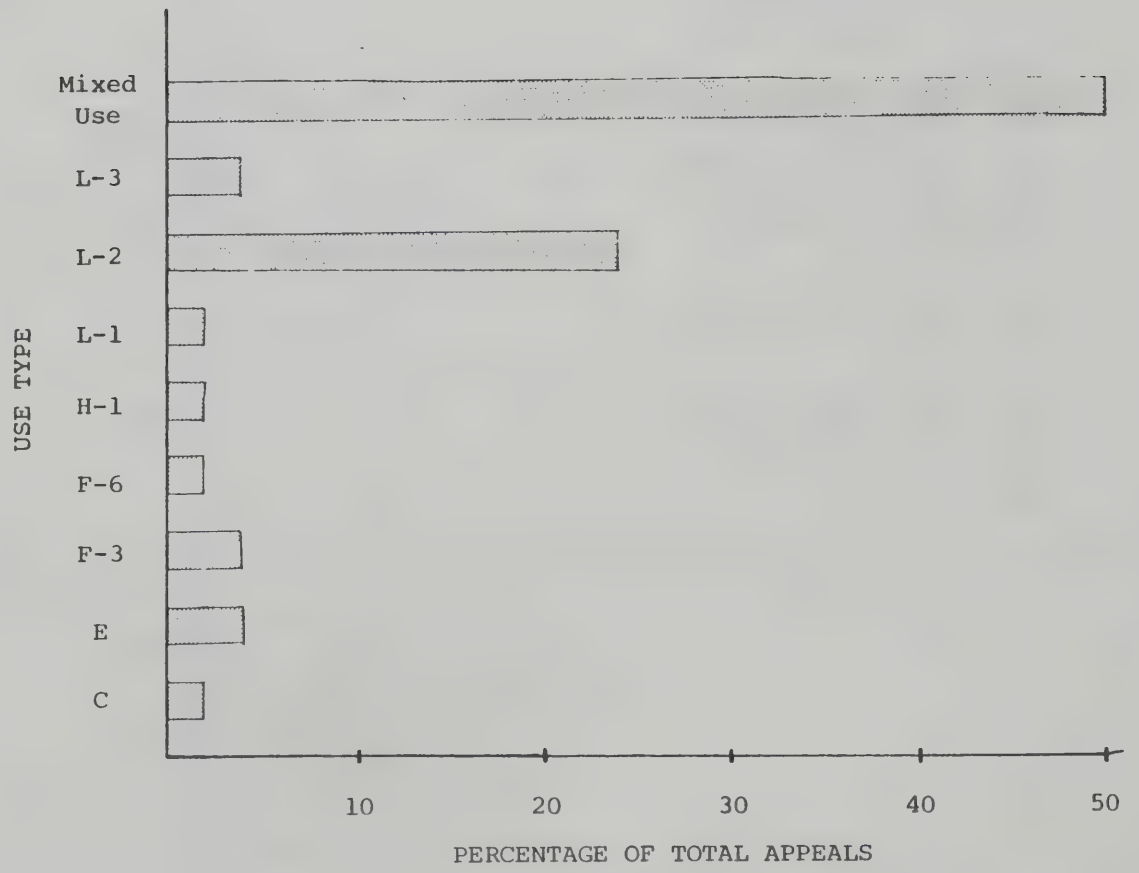
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN BOSTON, MASS. BY USE TYPE (FOR EXISTING BUILDINGS)
Data Chart 3

NOTES:

1) The graph examines the importance of use type as an obstacle to code compliance as indicated by appeals to the building code.

2) Building programs with mixed-use types required variances to the building code more often than any single use type in Boston.

3) Thirty-four (34) of the forty (40) appeals cases (85%) involved a change of use.



(See page 63 for information on data; page 80 for use type classifications.)

TIME FOR THE APPEALS PROCESS AT THE BOSTON BOARD OF APPEALS
Data Chart 4

NOTES:

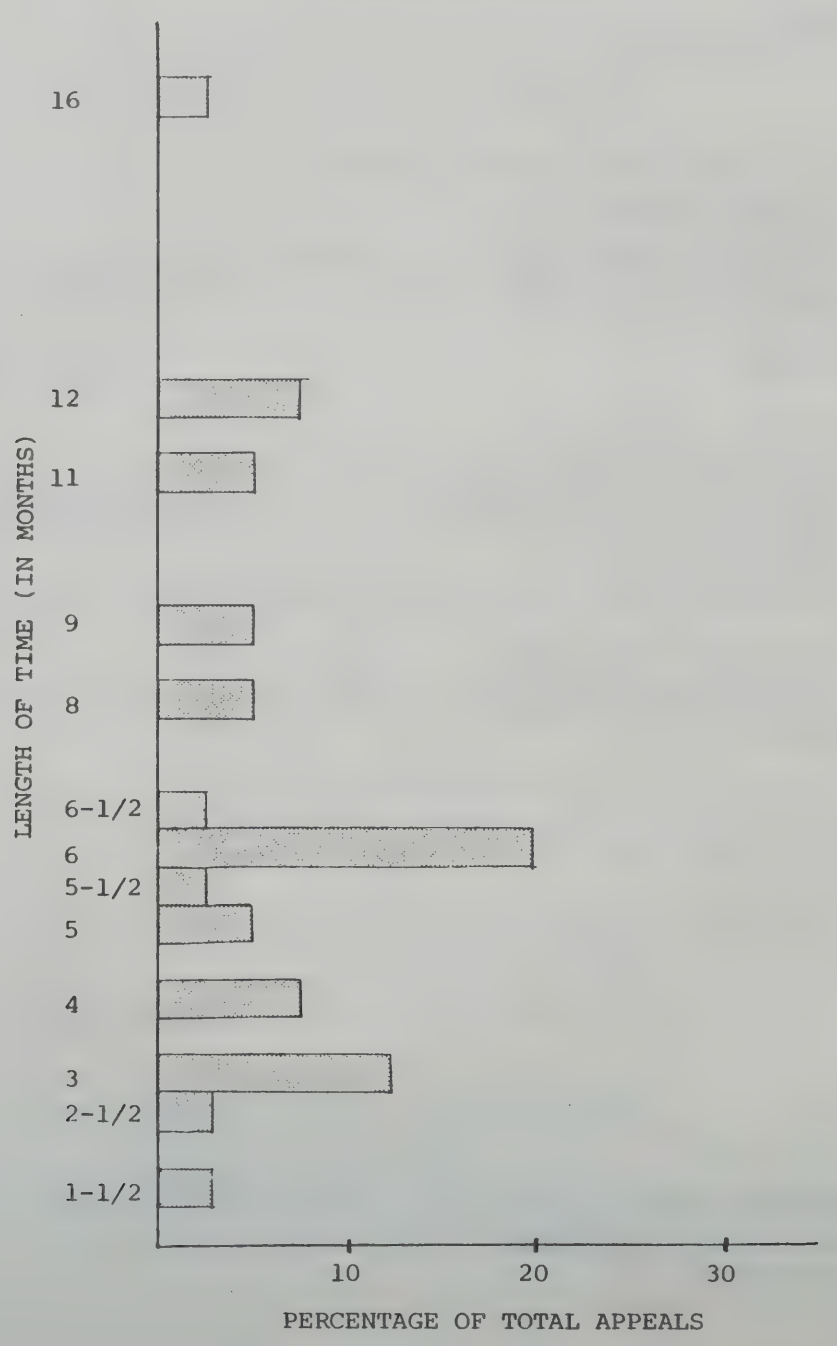
1) Time necessary to have a decision made on an appeal by the Boston Board of Appeals ranged from one and one half (1-1/2) months to sixteen (16) months.

2) The most commonly occurring time elapsed between the application for an appeal and the decision was six months.

3) The average time elapsed was 6.9 months.

4) 40% of all appeal cases were resolved between five (5) and nine (9) months.

(See page 63 for information on data.)



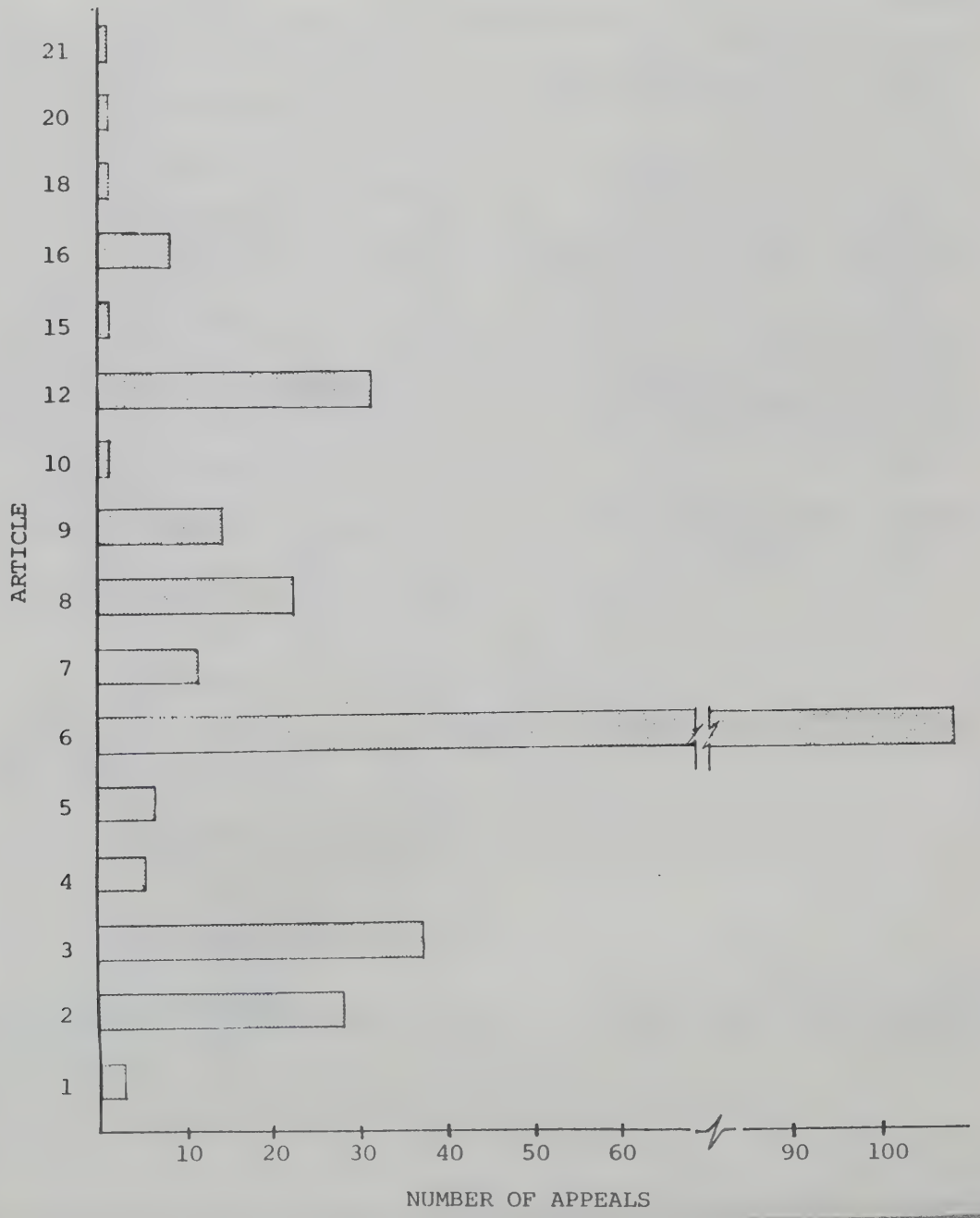
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN BOSTON, MASS. BY CODE ARTICLE (FOR EXISTING BUILDINGS)

Data Chart 5

NOTES:

1) Appeals to Article 6 constitute 39% of the total appeals in this sample.

2) Article 5, which the team perceived as a significant technical barrier to building re-use, constituted only 2% of the total appeals.



(See page 63 for information on data; page 77 for article titles.)

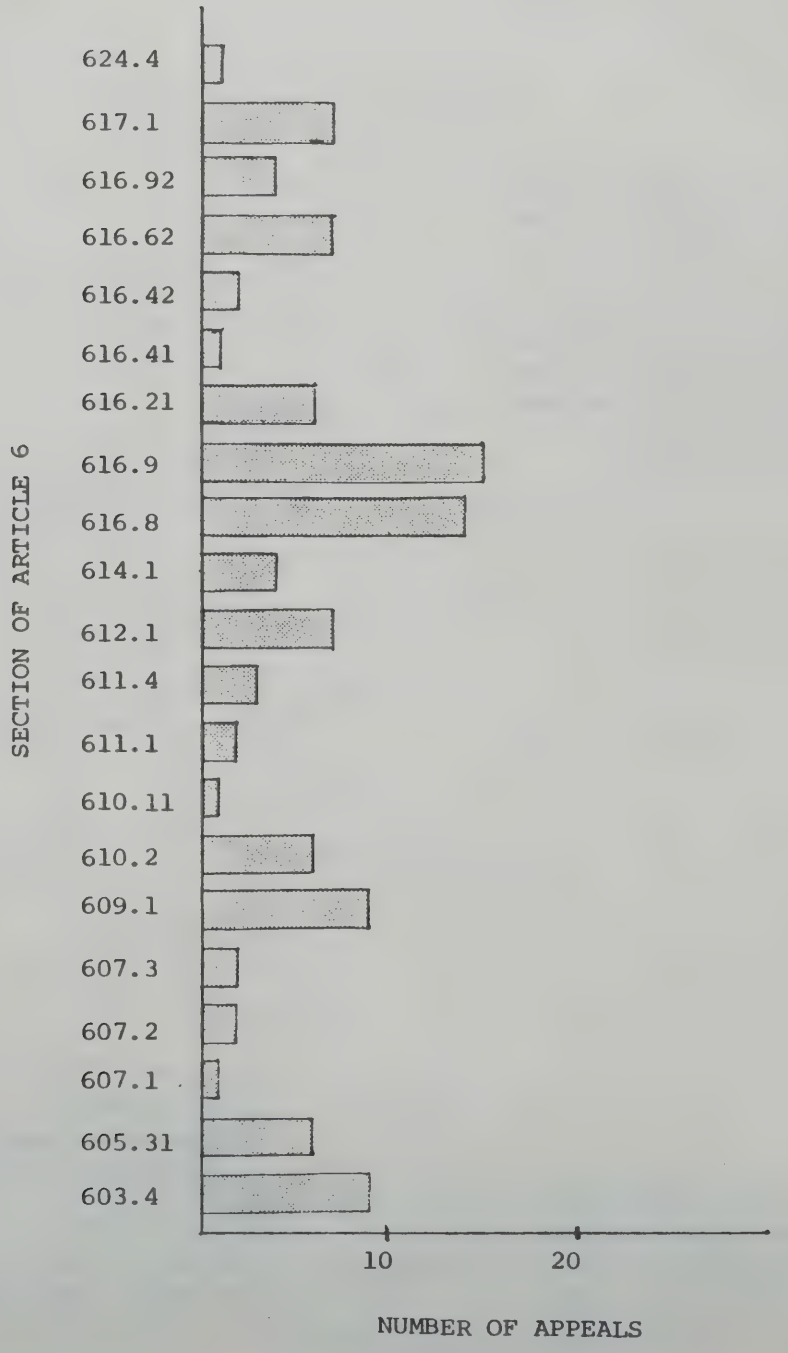
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN BOSTON, MASS. BY SECTIONS OF ARTICLE 6 (FOR EXISTING BUILDINGS)

Data Chart 6

NOTES:

Appeals to section 616 (Interior Exitway Stairways) constituted 45% of the total appeals to Article 6. Sections 616.8 and 616.9 (Supplemental stairs and stairway construction) apparently pose a significant obstacle for code compliance since 59% of appeals to section 616 were for these particular sections and 26% of the total number of appeals to Article 6 were for sections 616.8 and 616.9.

Refer to team discussion of Article 6 in Section I.



(See page 63 for information on data; page 79 for section titles.)

BOSTON BUILDING DEPARTMENT OPERATIONS: PERMITS AND DOLLAR VALUE OF NEW CONSTRUCTION AND ALTERATIONS
Data Chart 7

	PERMITS ISSUED			CONSTRUCTION VALUE (IN DOLLARS)		
YEAR	NEW	ALTER.	TOTAL	NEW	ALTER.	TOTAL
1967	466	5830	6296	178,806,800	37,705,500	216,512,300
%	7.40	92.60	--	86.74	13.26	--
1968	381	3618	3999	167,630,200	30,037,900	197,668,100
%	9.53	90.47	--	84.80	15.20	--
1969	353	3012	3365	87,696,800	64,058,300	151,755,100
%	10.49	89.51	--	57.79	42.21	--
1970	281	3715	3995	260,331,700	52,878,200	313,209,900
%	7.03	92.97	--	83.12	16.88	--
1971	303	4388	4691	433,831,000	50,193,400	484,024,400
%	6.46	93.54	--	89.63	10.37	--
1972	169	4319	4488	118,890,675	61,193,100	180,063,775
%	3.76	96.24	--	66.03	33.97	--
1973-4	326	7584	7910	113,867,787	88,651,302	202,519,089
%	4.12	95.88	--	56.23	43.77	--
1975	317	5112	5429	50,966,870	77,020,500	127,987,370
%	5.84	94.16	--	39.82	60.18	--
1976	181	5225	5406	40,811,716	112,903,729	153,715,445
%	3.35	96.65	--	30.07	69.93	--

SOURCE: Boston Building Department. Compiled by Paul M. Folkins in 1977.

TIME PERIOD: 1967 through 1976.

NOTES: This data is interpreted in the following two graphs (pages 69 and 70).

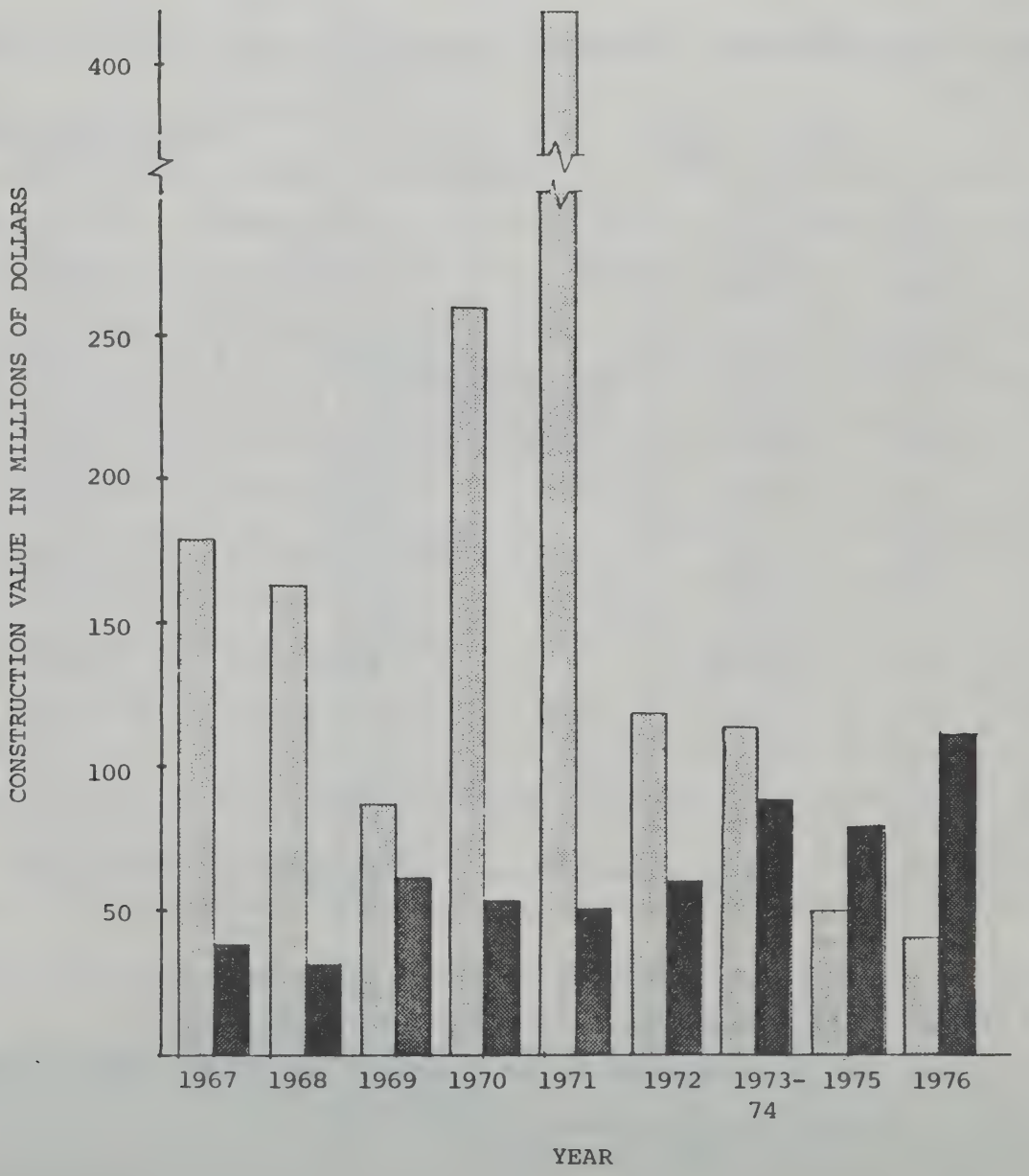
TOTAL DOLLAR INVESTMENT VALUE OF NEW CONSTRUCTION COMPARED WITH ALTERATIONS IN BOSTON, MASS.

Data Chart 7a

NOTES:

1) Dark shading indicates alteration value. Lighter shading indicates new construction value.

2) This graph is discussed in conjunction with the following graph (page 70).



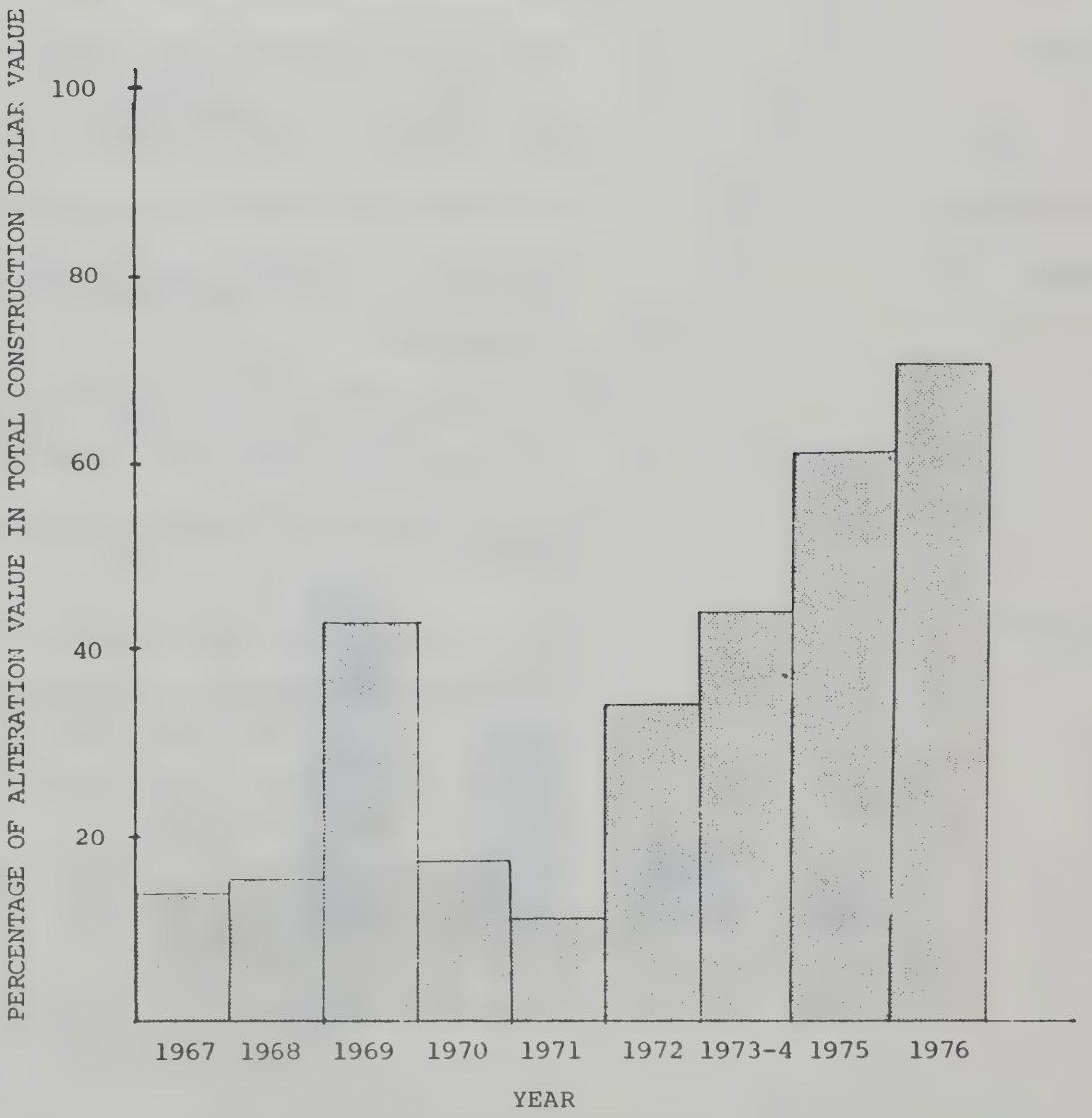
(See page 68 for information on data.)

ALTERATIONS IN EXISTING BUILDINGS IN BOSTON, MASS. AS A PERCENTAGE OF TOTAL CONSTRUCTION VALUE

Data Chart 7b

NOTES:

1. This graph when examined with the graph on the preceding page suggests that while alterations have grown, total dollars invested in the construction market have declined. 1967 marked $216 million total investment in construction and a correlated 86:13 percent ratios for new: alteration construction. 1970 and 1971 saw a sudden rise in dollar volume (to 313 million in 1970 and 484 million in 1971) and correlating sudden rise in alteration starts. 1976 shows a dollar volume of construction starts at 153 million, with the previously mentioned market control by the alteration sector, but the lowered total dollar volume, compared to 1967-1973, alteration starts may not involve as much dollar investment, despite labor intensivity, as new construction.
2. The data compiled also includes permits issued for building demoliton and boarding-up of buildings as part of alteration to existing buildings.



(See page 68 for information on data.)

Data Base : SPRINGFIELD, MASS.

SOURCE: Data in the following five graphs (pages 72 through 76) was compiled from appeals made for variances to local zoning ordinances and the Massachusetts State Building Code in Springfield, Mass. made available through the City of Springfield Building Department.

TIME PERIOD: Data covers all appeals made from July 1976 through July 1977.

NOTES: The data is complete, based on examination of all recorded appeals made to the City of Springfield Building Department during this time period.

Data was formulated from appeals made on behalf of existing buildings only. Of the sixty-three (63) appeals cases for the year study forty-nine (49) cases (78%) involved existing buildings.

Notes on each page indicate references and significant points of the graphs.

CONTENTS:

Data Chart 8: Springfield Appeals Comparison by Code Type

Data Chart 9: Appeals to the Massachusetts State Building Code in Springfield, Mass. by Use Type (For Existing Buildings)

Data Chart 10: Time for the Appeals Process at the Springfield Board of Appeals

Data Chart 11: Appeals to the Massachusetts State Building Code in Springfield, Mass. by Code Article (For Existing Buildings)

Data Chart 12: Appeals to the Massachusetts State Building Code in Springfield, Mass. by Sections of Article 6 (For Existing Buildings)

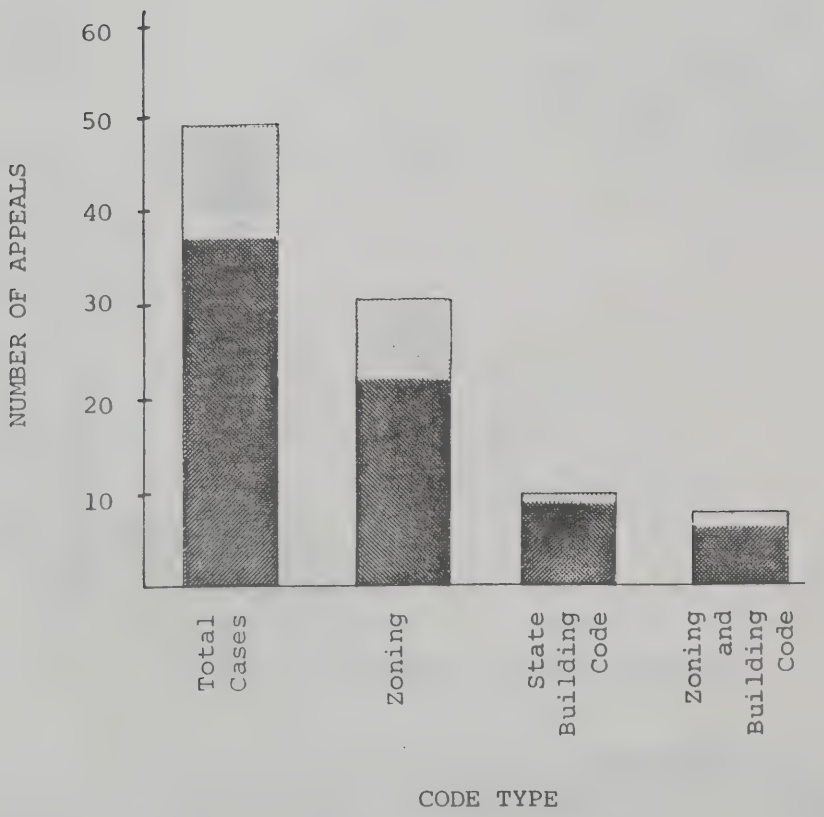
SPRINGFIELD APPEALS COMPARISON BY CODE TYPE

Data Chart 8

NOTES:

1) Shaded area indicates total number of appeals (involving existing buildings); dark shade indicates number of variances granted.

2) Appeals to local zoning ordinances outnumber appeals to the Massachusetts State Building Code three to one. Variances to zoning ordinances are granted in 72% of the appeals cases; variances to the building codes are granted in 90% of the appeal cases.



(See page 71 for information on data.)

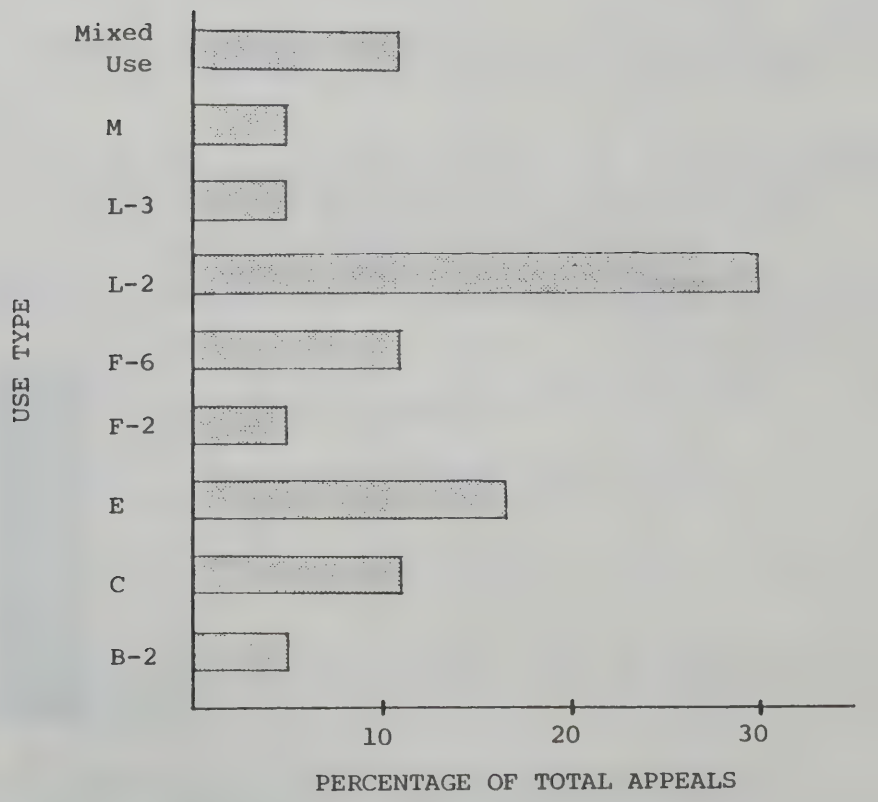
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN SPRINGFIELD, MASS. BY USE TYPE (FOR EXISTING BUILDINGS)

Data Chart 9

NOTES:

1) The graph examines the importance of use type as an obstacle to code compliance as indicated by appeals to the building code.

2) Building programs with a L-2 (multi-family residential) use type required a variance to the building code more than any other use type in Springfield.



(See page 71 for information on data; page 80 for use type clarification.)

TIME FOR THE APPEALS PROCESS AT THE SPRINGFIELD BOARD OF APPEALS

Data Chart 10

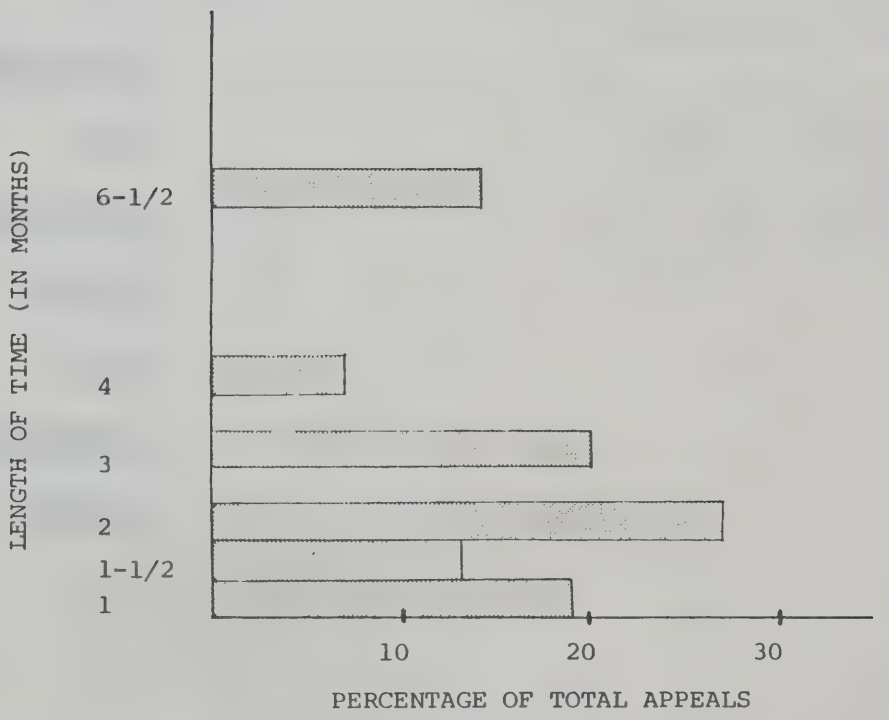
NOTES:

1) Time necessary to have a decision made on an appeal by the Springfield Board of Appeals ranged from one month to six and one half (6-1/2) months.

2) The most commonly occurring time elapsed between the application for an appeal and the decision was two months.

3) The average time elapsed was 2.7 months.

4) 79% of all appeals cases were resolved between one and three months.



(See page 71 for information on the data.)

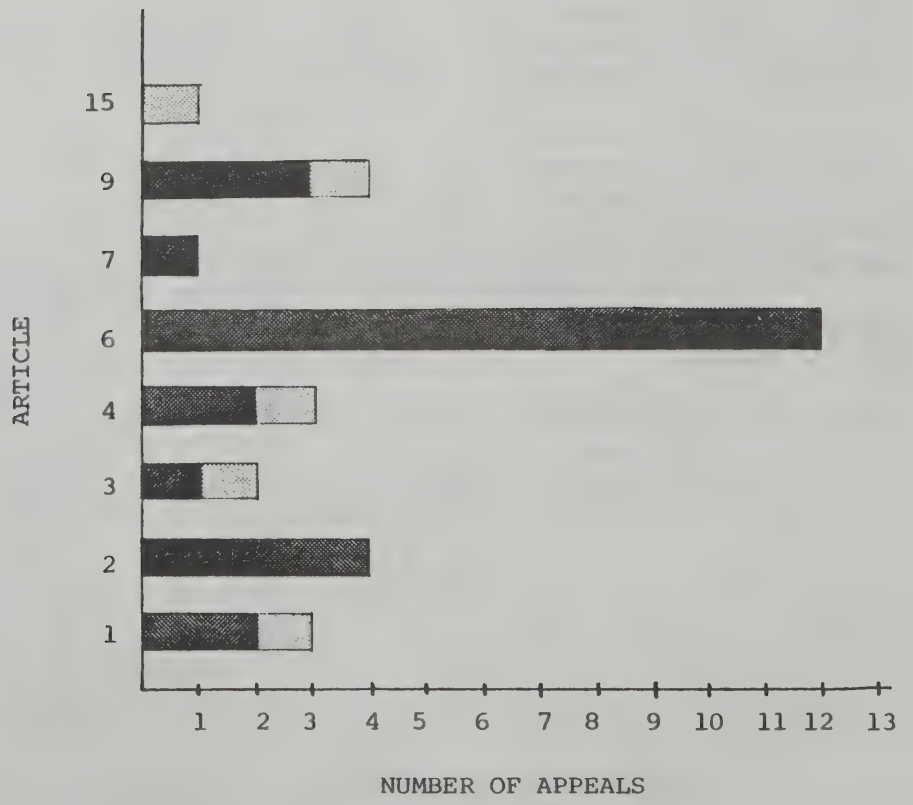
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN SPRINGFIELD, MASS. BY CODE ARTICLE (FOR EXISTING BUILDINGS)
Data Chart 11

NOTES:

1) Shaded area indicates total number of variances requested (involving existing buildings); dark shade indicates number of variances granted.

2) Appeals to Article 6 constitute 30% of the total appeals in this sample.

3) Article 5, which the team perceived as a significant technical barrier to building re-use was not appealed in Springfield during this time period.



(See page 71 for information on data; page 77 for article titles.)

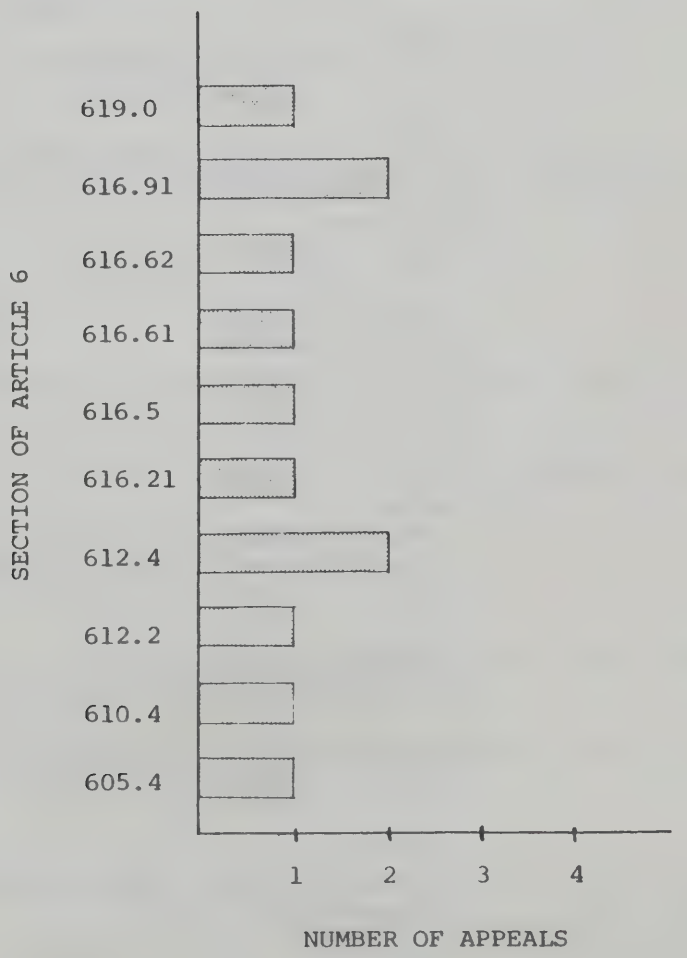
APPEALS TO THE MASSACHUSETTS STATE BUILDING CODE IN SPRINGFIELD, MASS. BY SECTIONS OF ARTICLE 6 (FOR EXISTING BUILDINGS)

Data Chart 12

NOTES:

Appeals to section 616 (Interior Exitway Stairways) constituted 50% of the total appeals to Article 6 although the actual number of variance requests is very small.

Refer to team discussion of Article 6 in Section I.



(See page 71 for information on data; page 79 for section titles.)

ARTICLE TITLES OF THE MASSACHUSETTS STATE BUILDING CODE

Article 1
Administration and Enforcement

Article 2
Definitions and Classifications

Article 3
General Building Limitations

Article 4
Special Use and Occupancy Requirements

Article 5
Light and Ventilation

Article 6
Means of Egress

Article 7
Structural and Foundation Loads and Stresses

Article 8
- Part A Materials and Tests
- Part B Steel Masonry, Concrete, Gypsum and Lumbar Construction
- Part C Building Enclosures, Walls and Wall Thickness

Article 9
Fireresistive Construction Requirements

Article 10
Chimney, Flues and Vent Pipes

Article 11
Heating Equipment and Appliances - Mounting, Clearances and Connections

Article 12
Fire Protection and Fire-Extinguishing Equipment

Article 13
Precautions During Building Operations

Article 14
Signs and Outdoor Display Structures

Article 15
Electrical Wiring and Fixtures

Article 16
Elevator, Dumbwaiter, Escalator, and Moving Walk Regulations

Article 17
Plumbing, Drainage and Gas Piping

Article 18
Air Conditioning, Refrigeration and Mechanical Ventilation

Article 19
Manufactured Buildings, Building Components and Mobile Homes

Article 20
Light-Transmitting Plastic Construction

Article 21
Building Code Provisions for One and Two-Family Dwellings

Article 22
Energy Conservation (Amendment to the code on Aug. 1, 1977)

REFERENCE FOR DATA

SECTION TITLES FOR ARTICLE 6
MEANS OF EGRESS OF THE
MASSACHUSETTS STATE BUILDING
CODE

Section	
600.0	Scope
601.0	Definitions
602.0	Plans and specifications
603.0	Use and occupancy requirements
604.0	Air-conditioned buildings
605.0	Existing buildings
606.0	Occupancy load
Table 6-1	Floor area allowance per occupant
607.0	Types and location of exitways
Table 6-2	Maximum length of exitway access travel (feet)
608.0	Capacity of exits
Table 6-3	Capacity per unit egress width
609.0	Number of exitways
610.0	Exitway access passageways and corridors
611.0	Grade passageways and lobbies used as an exitway element
612.0	Means of egress doorways
613.0	Revolving exitway doors
Table 6-4	Minimum clear doorway widths
614.0	Horizontal exits
615.0	Exitway ramps
616.0	Interior exitway stairways
Table 6-5	Door construction
Table 6-6	Minimum standards for stairway and enclosure construction
617.0	Access to roof
618.0	Smokeproof stairway enclosure
619.0	Exterior exitway stairways
620.0	Moving exitway stairways
621.0	Fire escapes
622.0	Slidescapes
623.0	Exitway signs and lights
624.0	Exitway lights

USE TYPE CLASSIFICATIONS AS REFERRED TO IN THE MASSACHUSETTS STATE BUILDING CODE

A	High hazard
B-1	Storage - Moderate
B-2	Storage - Low
C	Mercantile
D	Industrial
E	Business
F-1-A	Assembly theaters with stage and scenery
F-1-B	Assembly theaters without stage (Movie Theaters)
F-2	Assembly - Night clubs and similar uses
F-3	Assembly - Lecture halls, recreation centers, terminals, restaurants
F-4	Assembly - Churches
F-6	Assembly - Schools (Schoolhouses)
H-1	Institutional - Restrained
H-2	Institutional - Incapacitated
L-1	Residential - Hotels
L-2	Residential - Mulit-family
L-3	Residential - 1 & 2 family
M	Miscellaneous & temporary

REFERENCE FOR DATA

CONSTRUCTION TYPE CLASSIFICATIONS AS REFERRED TO IN THE MASSACHUSETTS STATE BUILDING CODE

Type 1: Fire-proof
 1A and 1B

Type 2: Noncombustible
 2A and 2B: Protected
 2C: Unprotected

Type 3: Exterior Masonry Walls
 3A: Mill
 3B: Ordinary Joisted, Protected
 3C: Ordinary Joisted, Unprotected

Type 4: Wood Frame
 4A: Protected
 4B: Unprotected

Administrative Profiles

ADMINISTRATIVE PROFILE: SPRINGFIELD, MASS.

Administrative Profile

The Building Department of Springfield currently supervises all construction in the city except construction of housing which is under the jurisdiction of the Department of Housing. (The Department of Housing is scheduled to be merged with the Building Department in the near future.) Under the direction of the Building Commissioner are 27 employees including 1 Senior Inspector, 4 Building Inspectors, 3 Plumbing Inspectors, 5 Wiring Inspectors, 1 Elevator Inspector and 1 Sign Inspector. All of the employees of the Building Department of Springfield are civil servants. Weekly meetings are held with the Building Commissioner and Inspectors to assess the status of current work and discuss problems. Each inspector is assigned a territory of the city which he constantly patrols and inspects. Hence, he can spot any illegal building activity and issue a letter of correction to the owner of the property.

Problems

The Building Officials find the State Building Code unclear on many issues and disagree with some of the provisions in the Code. The Officials will often refer to the old Springfield Building Code for clarification of confusing issues in the State code.

The building officials feel that codes adversely affect the city economically in certain sectors. To alleviate this, many variances to the State Building Code and zoning ordinance are granted when economic hardships will be incurred by compliance with code regulations.

ADMINISTRATIVE PROFILE: BOSTON, MASS.

Administrative Profile

The Boston Building Department is headed by the Building Commissioner, a politically appointed position. The Commissioner is aided by a Deputy Commissioner and two assistant Building Commissioners. Reporting to the Commissioner and his assistants are nearly 150 people that work in one of three divisions, the Technical Division, the Inspection Division, or the Administrative Division.

The Technical Division is responsible for issuing building permits which requires reviewing project plans and systems. The division is comprised of eight technically trained persons including two principal construction and safety engineers and chief mechanical, electrical and zoning engineers.

The Inspection Division is responsible for enforcing Building Code regulations. The Division is divided into four departments and employs more than 100 inspectors. The department of construction and safety inspects structural systems as well as overall building construction and repairs made in Boston. The mechanical department inspects elevators, gas fittings, sprinklers and plumbing systems. The electrical department inspects interior and exterior electrical systems. The egress department inspects means of egress in buildings.

The Administration Division is responsible for offering legal information, applications and general services to the public to aid them in Building Department procedures.

Problems

The Boston Building Department is subject to political pressure from the city government. Political interest in a project can influence the time involved for obtaining a building permit and the frequency of inspection of a project once under construction.

Boston building inspectors have been known to refuse to inspect building construction in wards of the City that are notorious for ethnic and racial crimes. Consequently, buildings in these communities are neglected by code officials and may possibly be unsafe due to uncontrolled or untested construction systems.

The Technical Division of the Building Department finds the State Building Code unclear on many issues. The building officials will often refuse a permit request for buildings that involve a decision by an official on an unclear issue. This forces the project owner to request a variance to the unclear code provision. Consequently, the City Board of Appeals takes legal responsibility for the decision which will often become precedent.

The following analysis chart (page 88) was derived from a plan and code review reference outline which is used as a checklist for mandatory training sessions given to all building inspectors in the State of Massachusetts. The outline was developed to be retained by building inspectors as a guide to plan review and inspection. In addition, the outline was designed to couple with future developments for specialized codes for existing building and a hierarchy of qualifications for building inspectors.

Conclusions from Analysis

The levels presented in the chart clearly delineate a decision hierarchy building evaluation and code compliance. Use group classification and general building characteristics which are significant determinants in building re-use are the primary criteria for determining a hazard rating for a building and, therefore, the most highly regulated by building code officials.

The risk of fire is viewed as the major hazard with protection of property stressed over life safety of building occupants.

Property maintenance and health and sanitation regulations are the low priorities for developing a hazard rating. Consequently, building inspectors will allow a wider range of solutions for these regulations.

ANALYSIS OF PLAN AND CODE REVIEW REFERENCE SHEET

LEVEL OF IMPORTANCE	CODE REFERENCES	ISSUES IN REFERENCES
1	Location/fire district height & area table use group/construction type	General building characteristics
2	Fire grading (Fire walls) exterior walls sprinklers/standpipes	Major property fire protection
3	Fire ratings of elements/ means of egress stairwell enclosures/structure loads/firewall	Life safety
4	Construction details of major structural elements	Structural stability of buildng
5	Roof covering, parapet walls, fire partitions, building hardware & finishes	Property maintenance (nonstructural construction)
6	Chimneys, fireplaces vent systems, ducts & vents	
7	Waterproofing ratproofing	Health & sanitation control
8	Review of construction types	

PLAN AND CODE REVIEW
REFERENCE SHEET
(State of Massachusetts)

TEXT

LEVEL 1

1. Location. . .
2. Area Per Floor
 Table 2-6. . .
3. Height. . .
4. Use Group (202.0 - 213.0)
5. Type of Construction (214.0 - 218.0)
6. Construction Control (128.0, etc.)

LEVEL 2

1. Fire Grading - Table 2-5. . .
2. Area Exceptions (Table 3-1, 308.0, 309.0)
3. Height Exceptions (310.0)
4. Allowable Bearing Pressure (723.0, 726.0)
5. Sprinkler Requirements (Enter from Height - Level 1, Item 3)
 (1212.0, Table 12-3)
6. Standpipe (1206.0, 1209.0)

LEVEL 3

1. Special Requirements, Article 4
2. Special Items, Article 3
3. Table 2-5, Fire Rating of Elements
4. Light and Ventilation Requirements, Article 5
5. Article 6 - Major Details
 I. Overall Means of Egress. . .
 II. Smokeprood Towers (618.0)
 III. Stairways (Table 6-6). . .

6. Article 7
 Loads. . .
7. a. Fire Walls and Openings (907.0, 908.0)

b. Party Walls (907.0, 907.10)
c. Fire Division Walls (907.8). . .
d. Fire Partitions (909.0). . .
e. Fireresistive Partitions (910.0). . .

LEVEL 4

1. Details of Construction - Article 2 (214.0 - 218.0)
2. Size of Doors (612.0, 613.0, Table 6-4)
3. Details of Construction of
 a. Walls (Article 8)
 b. Floors (Article 8)
 c. Roofs (Article 8)
 d. Foundations (Article 7). . .
5. Firestopping (874.0, 921.0)
6. Fireproofing (874.0, 921.0)
7. Special Requirements of Article 9 (905.0, 906.0)
8. Beams and Girders (913.0)
9. Columns (914.0)
10. Trusses (915.0)
11. Sprinkler Requirements - Details
12. Fire Alarm Systems (1218.0)
13. Egress Lighting (623.0, 624.0)

LEVEL 5

1. Roof Covering (903, 923)
2. Parapet Walls (867)
3. Foundation Walls (868.0)
4. Fire Partitions (909)
5. Fire Resistive Partitions (910.0)
6. Ceiling Fixtures
7. Exterior Opening Protectives (916.0)
8. Fire Doors (917.0)
9. Fire Windows and Shutters (918.0)
10. Wired Glass (919.0)
11. Interior Finish and Trim (922.0)
12. Automatic Fire Doors and Dampers (1810.0)

13. Inlet and Outlet Openings (1811.0)
14. Door Hardware
15. Opening Protectives (916.0, 919.0)

LEVEL 6 (Articles 10 & 11)

1. Chimneys (1007.0, 1008.0, 1009.0)
2. Chimney Connectors (1010.0)
3. Vent Systems (1011.0)
4. Fireplaces (1012.0)
5. Metal Ducts & Vents (1017.0)
6. Fire Resistant Requirements for Heat Appliance Foundations (1106.0 - 1112.0)
7. Boiler Rooms (1113.0)

LEVEL 7

1. Review Article 8A as it applies to Materials
2. Waterproofing (871)
3. Ratproofing (872)
4. Protection Against Decay & Termites

LEVEL 8 - REVIEW BASED ON TYPE OF CONSTRUCTION

Steel (827.0 - 834.0)
Masonry (835.0 - 840.0)
Concrete (841.0 - 850.0)
Wood Frame (851.0 - 855.0)

III RESEARCH AGENDA

III. RESEARCH AGENDA

INTRODUCTION

The purpose of this section is to propose specific research insuring the necessary resolution of regulatory barriers to building re-use. The agenda represents a conclusion to the team's study, and is drawn from Section I, Team Perceptions, and Section II, Data Base. The team identified six agenda areas: historical, behavioral, technical, educational, administrative, and social. The team concurred that inquiry in all of these areas is necessary for long range solution of code-rehab problems and that all six areas bear on the establishment and administration of a firm technical base.

1. HISTORICAL ISSUES

Intent: To identify and evaluate the operative technical bases of all sections of the codes.

Investigation

Based on the team's perceptions that codes are not up-to-date or based on current research, the team recommends investigation of the origins of code provisions. Comparison between these origins and current research should reveal technical discrepancies in the code.

2. BEHAVIORAL ISSUES

Intent: To establish the importance of behavioral information for the technical base by examining how research on behavior can be related to code standards.

The team recognized the need to examine behavioral research in order to establish a sound technical base for code provisions. Compiled research might include information on mobility in different environments, windowless environments, motivations and fear as factors in building evacuation. Such a research effort would involve behavioral scientists examining the codes for their implications to current research.

3. TECHNICAL ISSUES

Intent: To develop sound technical models for relative safety and health, and position existing buildings within models.

The team recognizing that existing systems and new systems must be measured against standards of safety and health. The team recommends the investigation of safety levels based, for existing buildings, on use type, construction type, occupancy levels, and configuration. The team recommends that research on safety or hazard levels include some

	testing of building types, and much modeling based on test results. An administrative model for trade-offs and compliance over time and an incentive model for owner compliance would aid in code enforcement.
4. EDUCATIONAL ISSUES	
Intent: To provide a more capable corps of code inspection officials.	The team recommends that minimum educational requirements and qualifications for code officials be investigated based on the work scope suggested by the code-rehab issues. A training program, based on issues, risks, technical systems and evaluation of existing buildings, should be developed.
5. ADMINISTRATIVE ISSUES	
Intent: To simplify the code administration bureaucracy.	The team recommends an examination of code bureaucracies with the intent to simplify administrative processes. For the code itself, the team recommends clarification of the intent of code provisions in order to provide a clear context for decision-making.
6. SOCIAL ISSUES	
Intent: To determine the social vs. economic cost benefit of codes.	The team recommends examination of the informal sector to weigh the effects of code compliance on availability of housing and relative safety of housing.
To identify values implicit in current code provisions.	An examination of the social implications of code provisions would reveal the underlying social biases of the code. By determining the social values implicit in a code one can establish how the code reflects current lifestyles and value systems, and the extent of the role regulatory processes play in establishing types of social environments.

APPENDIX

APPENDIX 1

RESEARCH AGENDA

Norton S. Remmer, P.E., Commissioner
Dept. of Code Inspection, City of Worcester

OVERVIEW

General

There is an apparent increased interest in the re-use and rehabilitation of what are called "existing" buildings. "Existing" buildings are considered as buildings which were built prior to some recognized regulations. The interest has been identified with several possible reasons. One reason is a desire to retain some irreplaceable features of existing buildings which could never be duplicated, and some aesthetic characteristics which provide unique environments. In essence this is a "preserving the heritage" rationale. There is also the supposition that it is wasteful to tear down potentially useful buildings, and there should be a way to re-use any building which provides some vestige of a useful structure.

The apparent interest in these buildings may not be because of any fundamental surge in desire to re-use them, but may reflect the sudden convergence of many circumstances that suddenly make them more difficult to re-use. Where re-use may have been previously taken for granted and allowed to proceed with minimum regulatory requirements, there is now, suddenly, an incredible number of new regulatory provisions which may apply. This is true not only in building codes, but in zoning and housing codes and local, state and federal requirements.

General Regulatory Controls

Buildings, both new and existing, must face a gauntlet of controls before they can even reach the point where the actual physical details of the building have to be specified. Figure 1 shows a network of approvals which any building, old or new, may be subject to. It is only after establishing the potential of complying with all of these requirements that an existing building may have the possibility of becoming viable. At that point viability depends on conformity.

Re-Use and Administrative Regulations

There is no question that re-use of buildings, in one form or another, has been going on for years. As more dangers in buildings have been recognized, especially due to fires, more requirements have been imposed on new buildings. Many of these requirements have found their way into regulations for existing buildings also. There have been many mechanisms for the transfer of these regulations to existing buildings. Some are deliberate and are either rational or irrational. Others are unintentional and produce results that are often irrational. Some of the mechanisms include statutory requirements of local ordinances or by-laws, and may be the result of emotional rather than rational decisions. Some presumably rational requirements are embedded in vague administrative language or relate to obscure origins. The following is an example of one of these vagaries. Article 19 of the BOCA model code, which controls "Light Transmitting Plastics" has one important section which was the result of a change from the 1975 edition. The commentary accompanying the change indicates that the provision was eliminated from the 1975 edition. The reason for eliminating it does not exist and the commentary speculates that it might have been eliminated by mistake and that the provision is reinstated because of the possibility that there might have been a mistake. There is no discussion of whether there was any value of the provision, or whether it had created or relived hazards during its three-year tenure. Thus, the item is inserted without any reference to purpose or value.

The Exponential Increase in Regulatory Controls

In the past several years, and eight years is a convenient number to use in this case, there has been a very nearly exponential increase in the volume, complexity and scope of regulations affecting buildings - both new and existing. A few of the major areas are sprinkler systems, fire detection systems, material controls, specialized ventilation requirements for smoke, energy conservation requirements and seismic resistance requirements. In addition, the supporting system of national standards which controls many of the products used, and the approvals systems, have become more complex. As more real dangers are identified in all buildings, more regula-

tions have marched along to meet them. The result is an incredible increase in the amount of technology and specification applicable to all buildings to provide minimum standards for all perceived objectives.

SECTION I

New Building Characteristics

New buildings are designed for specific purposes in a location which accommodates specific needs with economics based on purpose, location and other factors which are relatively predictable. In contrast, existing buildings must find a use adaptable to location, physical layout and economics imposed on its rehab and use. It is extremely difficult to match an existing building to an economic potential use without major concessions from an ever increasing number of even more restrictive regulatory processes.

Code requirements for new buildings are relatively easy to standardize - whether they are prescriptive or based on some performance capability. The presumption is that the standardized guidelines accommodate all the elements of safety, health and welfare prescribed for public benefit. It is then possible to assemble a building using allowed variations of all of these elements to accomplish the objectives established for safety, health and welfare. The combination of all these elements, while individually conforming to the conditions for achieving a presumed objective, are not capable of being described in any definitive aggregated terms. Thus, for these considerations we can't express an equivalent provided by other methods. For instance, for structural requirements we can say that the building roof has the equivalent of a 40 pound per square foot live or snow load capacity, or the building can withstand without significant damage a certain level lateral force - either wind load or seismic. In an existing building we can only investigate the artifacts of what exists to analyze individually how close the elements come to current individual specifications.

But in current codes, if any element isn't exactly as currently required, it is not in compliance. Even if we have some individual elements that may be able to compensate for other inadequate elements, we cannot assess the aggregate performance. Therefore, the entire building performance may be unjustly penalized.

Identical Problems for New and Existing Buildings

There are regulatory, and especially code, problems which are identical for new and existing buildings.

1. Most code administrative requirements are either explicitly defined or are open-ended and vague. The intent, of course, for any administrative requirements is to package the rest of the code into the proper technical and legal procedures. However, where the requirements are explicitly defined and absolute they eliminate the potential for intelligent problem solving on a recognized ad hoc basis; and where they are vague and open-ended they may penalize buildings. In many cases the administration is left to the discretion of the building official. I have seen many instances where the discretion of one building official is totally discredited by his successor. Thus, without any additional guidelines, those provisions which blithely say "such that the public safety is not increased," or "at the discretion of the building official, but such that no greater hazard is imposed" are calmly inserted time-bombs in existing buildings for every subsequent alteration or change of use. The succeeding building official decides he cannot accept anything previously approved at the discretion of the previous building official and an unending iteration is started.

2. Technical and prescriptive requirements provide no reference base. What has been established as regulation for new buildings is the only reference base available.

It is necessary to relate all requirements for existing to those for new. If it is possible to identify changes to provisions for existing buildings then it is ncessary to simultaneously question provisions for new buildings.

It has often been said that existing buildings cannot survive with the prescriptive standards imposed by codes created for new buildings. It has been proposed that more flexible standards be allowed for existing buildings. Presumably, any such standards which are acceptable to meet objectives for safety, health and welfare in existing buildings are just as acceptable for new buildings.

3. Many code problems result from inaccurate format and language. Decisions are based on semantics rather than technology or experience. Language and cross referencing in many places is vague because those responsible cannot decide:

a) Where regulatory discretion should begin or end or what specific decisions should be encompassed by discretionary decision making.

b) What situations may be encountered or created by the provisions, and therefore the requirement is left vague. The full extent of interactions or effects on other requirements is not fully explored and evaluated and consequently technical issues become semantic issues.

Regulatory Responsibility

Any system developed to accommodate the specific needs of existing buildings must also question the acceptable limits of regulatory responsibility.

If all decisions relating to re-use of existing buildings were left to design professionals the assumption would be that they are capable of making the following decisions:

1. What is actual risk involved to

a) Life safety

b) Health

2. What is the appropriate level of risk/benefit where benefit relates to the public's benefit and includes considerations of life safety risk, health risk to the community, social benefits, etc.

There is the assumption that the design professional must in effect be deputized to assume these decision making powers, and in effect acquires "police powers" which are not his statutory responsibility. As a corollary to the stated assumption there is a question of implied liabilities.

The role of the building official must also be examined. Would he negotiate solutions for existing buildings and how are compromises achieved?

If it is assumed that such a process occurs, and an existing building is changed in use with provisions the primary responsibility of the design professional, the question arises of what happens on the next change of use with a different design professional - and possibly a different building official.

Local Policy

An excellent example of the importance and significance of local policy relating to its existing buildings occurred in Worcester, MA.

A disastrous fire occurred in an old lodging house in Worcester. The lodging house existed by virtue of the "grandfather" allowances which existed in the applicable codes. The level of safety provided by the building was proved by the fire to be totally inadequate to ensure life safety. Through legislation that was passed shortly after the event the city was able to invoke requirements for fire detection systems and impose certain requirements for meeting current code standards in all of the existing lodging houses. This was pursued vigorously. It is important to note that an overt public policy decision was made to impose strict regulation and enforcement in recognition of a level of risk existing which was not acceptable. The result of this policy decision is significant for this discussion because the result was that many lodging houses were demolished.

These former lodging houses were not economically sustainable with the new requirements. Furthermore, they could not, considering their location and character, be economically transformed to anything else. Their continued existence, even uninhabited, constituted a distinct threat to the rest of the neighborhood. As a result of all of these factors, the number of lodging houses in the city has declined by about one third, with many of them having been demolished.

There are many arguments that could be forwarded saying "the codes" impeded re-use. But in fact, many of these lodging houses were changed in use from apartment houses, tenement houses and hotels and never brought up to a reasonable code standard. Over a period of years a significant portion of the lives lost in fires in the city occurred in these lodging houses.

It appears clear that there was a certain level of risk inherent in these buildings which, in many cases, if allowed to exist with no attempt at mitigation, allowed them to remain open. But if it was necessary to attempt to mitigate that risk, they were no longer economically sustainable for any purpose and became a liability for the city and the neighborhood.

SECTION II

Achieving Compliance of Existing Buildings

There appears to be three fundamental methods of achieving compliance in existing buildings. Although the primary concerns for achieving a standard of code compliance in existing buildings are related to fire safety, the three methods relate to most concerns which codes impose on buildings. The methods are as follows:

1. The use of equivalencies or equivalent systems, elements, components, etc., to meet new requirements, wherever such an approach would be appropriate. Examples might be to add elements to existing walls and floors to achieve a prescribed fire rating or adding egresses to compensate for egresses which are narrower than allowed.

2. Using trade-offs to make adaptations which provide different but equal conditions or systems. Examples might include sprinklers, smoke detectors, and experience based allowances.

3. Using a method of risk analysis to provide complete flexibility in achieving an overall safety objective equivalent to a certain minimum agreed standard. Examples of methods are those used by the Center for Fire Research of the National Bureau of Standards as used in "A System of Fire Safety Evaluation of Health Care Facilities," or by the National Fire Protection Association as used in their "Fire Safety Systems Analysis for Residential Occupancies" prepared for the Department of Housing and Urban Development.

The three methods of achieving compliance will be explored further in the following sections.

Equivalencies

The basic report includes many specific examples of equivalencies required to allow using existing systems, components or elements, augmented in various ways to provide specific performance objectives. Thus, flexible combinations of natural and articial light and ventilation could be used providing that some understanding of the real needs associated with each of these requirements is established.

Ths most common problem requiring a system of equivalencies is for specific fire rated systems. Systems which are fire rated are prescriptively specified. Identifying the value of non-standard systems, older materials, or combined systems relates partly to an institutional problem. The few recognized fire testing agencies approve most of the fire rated assemblies for acceptance by building officials. At present there is no system which is officially recognized for extrapolating out analytically from prescribed systems to accommodate existing systems or parts of existing systems which could be altered. In addition, there is a question of whether existing buildings, as a matter of policy, should be required to achieve 100% compliance or equivalence in all systems. This question implies the

identification of a factor of safety, which we are not aware exists as a definitive factor.

Egresses are another example of the need for fundamental equivalencies. It is clear that although a 24 inch egress does not comply with current minimum egress standards, it is also clear that by providing 20 of these egresses where two standard (42") egresses might be required, a higher degree of safety is provided (although there are no applicable approved methods of proving this). However, the question becomes, how many less than 20 would provide the equivalent to the code requirement. This must be studied, and as a representative of a family of similar problems, these equivalencies must all be evaluated and expressed in useable terms.

Trade-Offs

There are many "trade-off" possibilities available, both in terms of "hardware" and in terms of what might be called "software." Software is intended to include the use of such concepts as the control of occupancy in terms of physical capabilities of inhabitants, controlling the time allowed for egress and limiting the total capacity. Solutions using hardware generally involve the incorporation of such things as smoke/heat detectors and sprinkler systems. It might also include the control of the contents of buildings to limit hazard, total fuel load, flame spread and smoke density. These concepts are demonstrated in several hypothetical graphs which represent potentially useable guides for designers and officials. Figure 2 shows a relationship between the performances of a partition, a partition with smoke detectors, sprinklers, and a combination of all three in terms of some measure of probability of survival. It can be seen that a 2 hour partition might be replaced by a 1/2 hour partition, sprinklers and smoke detectors, as a 2 hour partition. In Figure 3, which is described in the NFPA report "Fire Safety Systems Analysis for Residential Occupancies" a relationship between flame spread rating, fuel loading and life safety are predicated. Using HUD's Minimum Property Standards as a reference the graph shows the variations possible in the relation-

ship between fuel loading and flame spread rating to achieve the same life safety objective. In a paper at the NCSBCS Conference of September 20, 1977, William McLain presented a paper on "The Role of Fire Prevention and Control in Building Construction and Regulations." The paper details an approach which determines a statistical "compartment level of risk" for each room of a dwelling and then discusses specific methods of altering the level of risk through such things as sprinklers, compartmentation and fire detectors, to achieve a prescribed acceptable level of risk.

Finally, there are many specific instances of risk mitigation which relate to broader concepts. In BOCA sections 905.6.1 and 905.6.2 the provisions allow for an increased height in certain residential structures when the basement has a certain high fire resistance rating and is compartmented. These sections are clearly related to experiences observed and evaluated intuitively. In reality, these provisions relate to a perceived risk analysis that has been intuitively evaluated and has provided two empirical requirements. The reasoning which establishes these provisions is identically related to the fundamental process that is proposed in Mr. McLain's paper referenced above, and is further developed by the HUD/NFPA systems analysis approach to risk. The extension of these approaches, or any other fundamental analytical approach, would be to provide the ability to apply specialized requirements to a multitude of uses and types of construction to allow greater flexibility both in the design of new buildings and the use of existing buildings.

It is important to note that in BOCA section 905.6.1 the requirements imply that by complying with those specialized conditions, the risk to the rest of the building is known to be considerably diminished. Projecting from that assumption it seems clear that if we are dealing with any existing residential building and the building above the basement is in a significant state of non-compliance with the current code, just by complying with 905.6.1 relative to the basement, we have significantly altered the risk without doing anything

else. This also argues that we should be able to evaluate the extent of risk mitigation and use it to benefit the building in other areas of code requirements. In the case described the two most likely beneficiaries would be height and area limitations.

Overall Safety Objective

The most comprehensive and flexible approach to achieving a standard of useable compliance in existing buildings is through a systems analysis approach. However, such an approach implies that there is an acceptable standard against which to measure standards or objectives of compliance. The standard presumed is that which controls compliance in new buildings. In the HUD/NFPA project, the standard of measure was the HUD Minimum Property Standards for One and Two Family Dwellings. In all cases of extant codes it is clear that the system standard is not defined and consequently any variations from standards produces unknown effects on the overall objectives implied by the codes. As an example, the limitations for height and area in buildings are step functions. Non-compliance occurs as soon as the limit established is exceeded. This kind of binary control is certainly not representative of the real range of risk associated with such standards, and it would be necessary to introduce a more realistic basis of aggregated compliance.

Conclusions

Buildings are subject to many regulatory controls. Being able to couple an existing building with an economic use is a matter of many factors in no way associated with codes. Many buildings should not survive and mitigating code compliance to achieve economic parity may produce disaster. Any attempt at achieving code compliance should be able to use new technologies as trade-offs or supplements but should recognize objectives which are definitively stated in terms of performance and risk. This can be accomplished by aggregating the performance of elements and components, or by achieving a systems objective. But there still remains a fundamental unanswered question which relates to new building objectives as well as existing. Have we ever been able to state the real objectives of any codes in terms which are useable to regulatory agencies, designers and users?

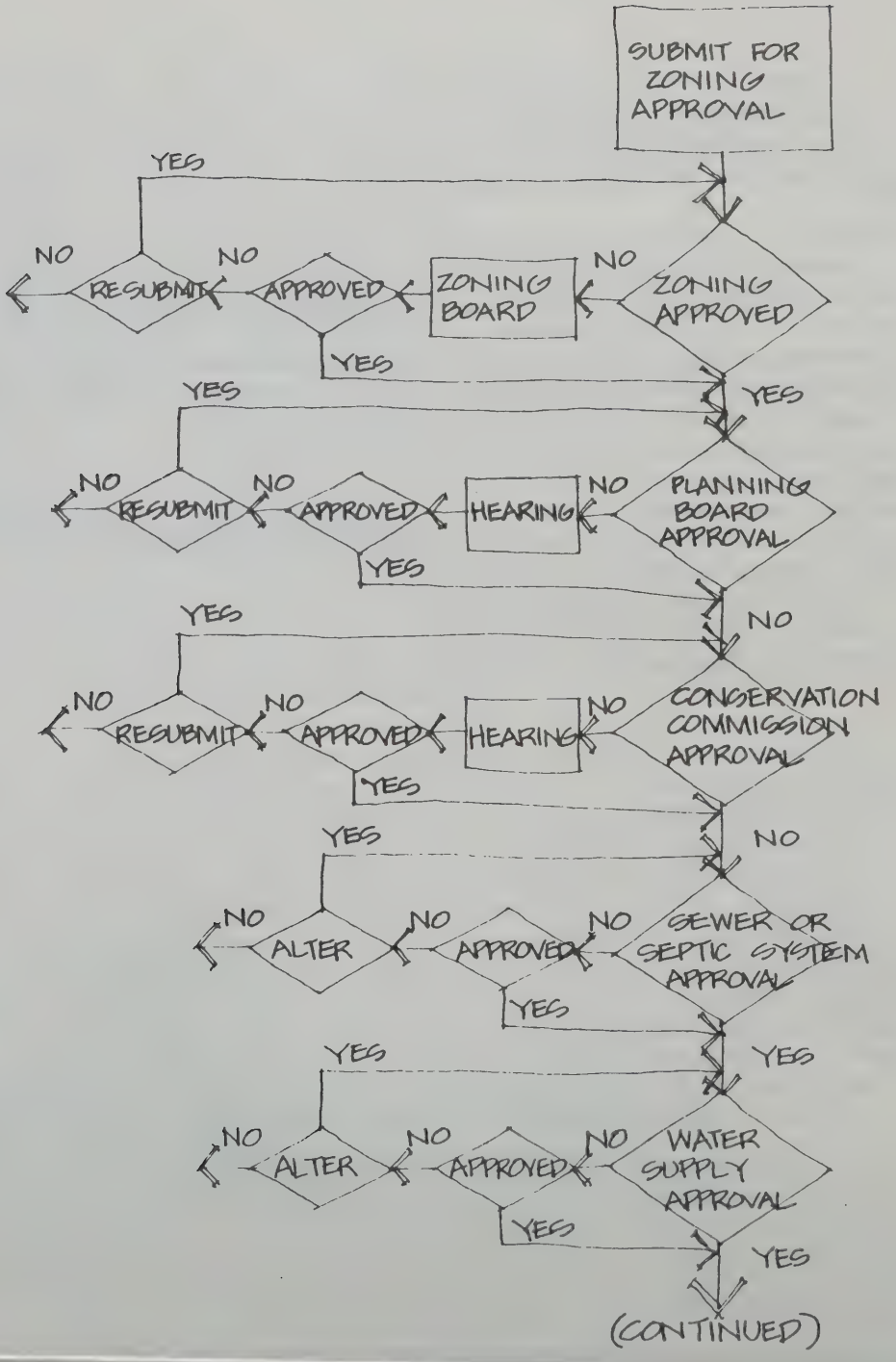
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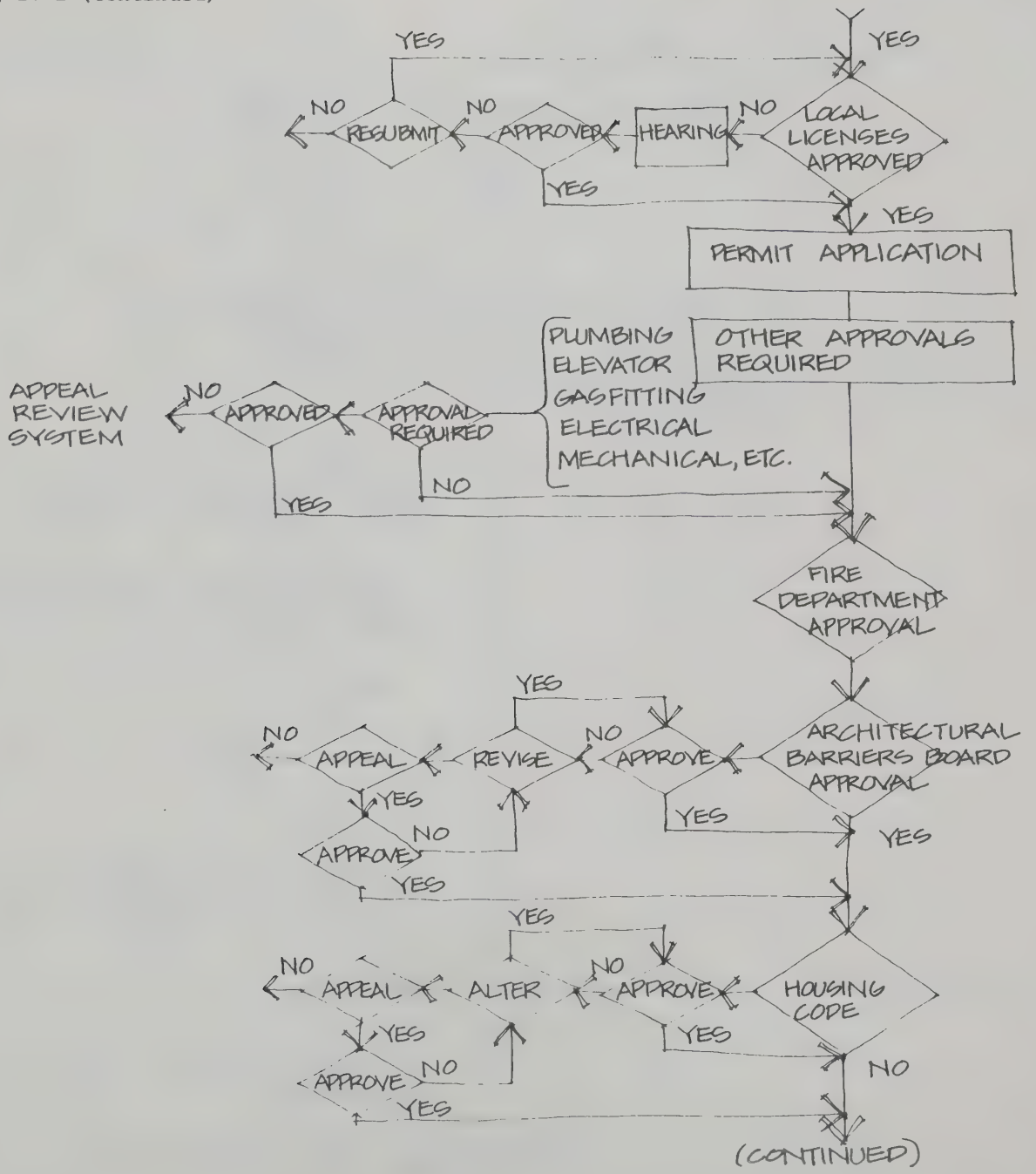
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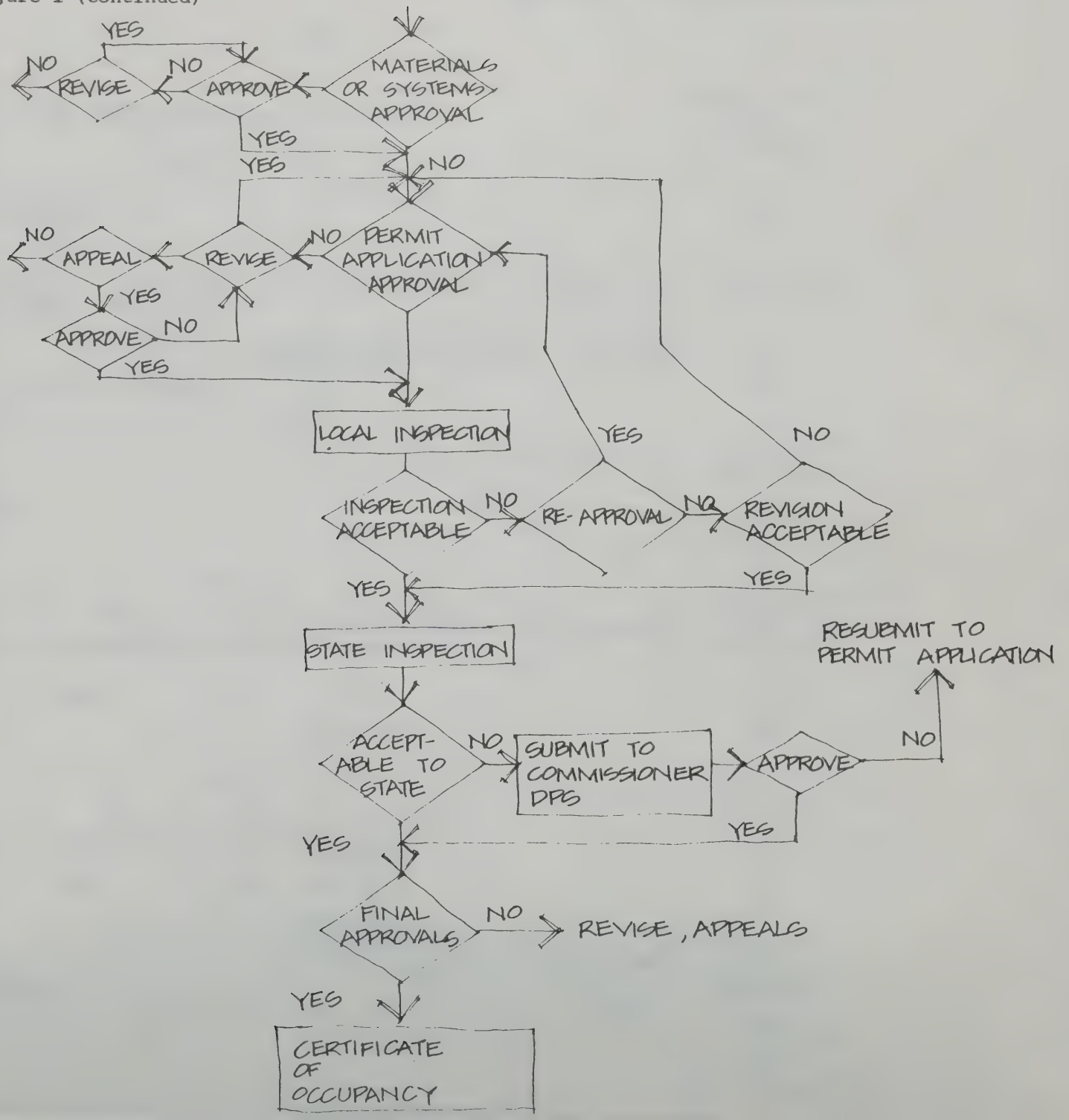
REGULATORY PROCESS
Figure 1



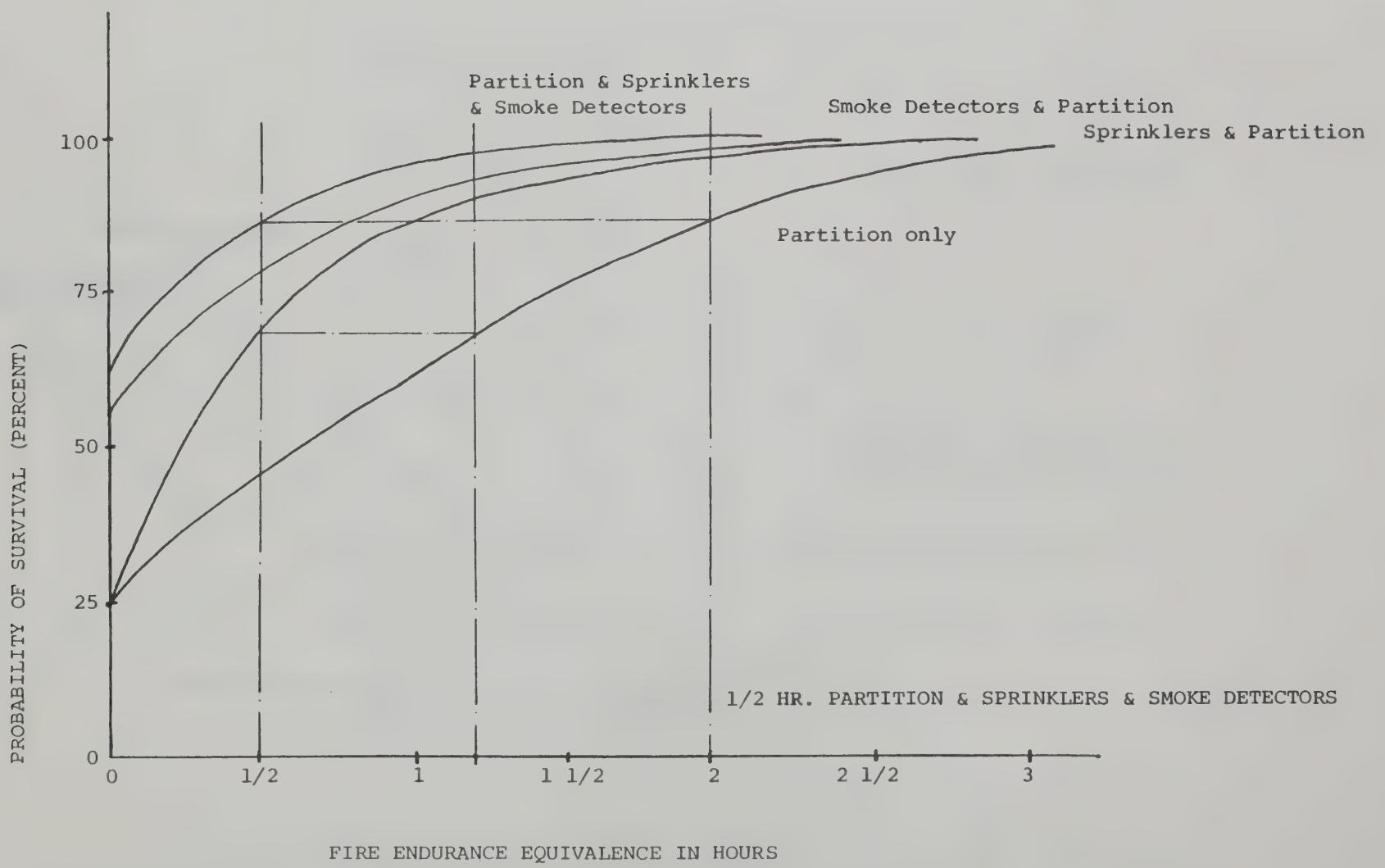
REGULATORY PROCESS Figure 1 (continued)



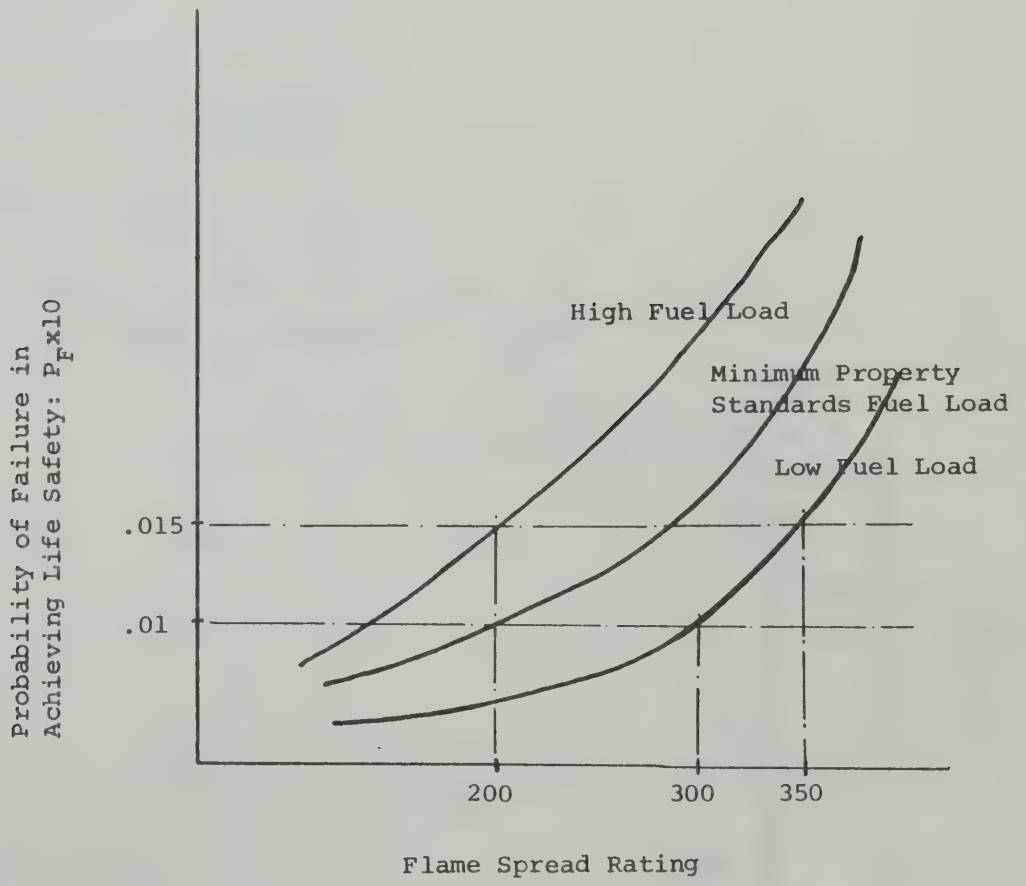
REGULATORY PROCESS Figure 1 (continued)



HYPOTHETICAL EQUIVALENCE:
PARTITIONS, SMOKE DETECTORS AND SPRINKLERS
(N.S. Remer)
Figure 2



HYPOTHETICAL RELATIONSHIP FROM HUD/NFPA REPORT:
"FIRE SAFETY SYSTEMS ANALYSIS FOR RESIDENTIAL OCCUPANCIES"
Figure 3



EXAMPLES

EXISTING BUILDINGS	PROBLEMS/SOLUTIONS
Problem	Solutions
Excessive area for use group and type of construction	1. NFPA/HUD risk analysis 2. McLain type risk trade-off
Excessive height for use group and type of construction	3. Specific code solutions such as BOCA 905.6.1 and 905.6.2
Determination of type of construction	
1. Identity of materials 2. Identity of fire materials	1. Evaluation of existing materials for strength and fire resistance 2. Research on methods of projecting, analytically and empirically, fire-ratings of non-standard assemblies
Meeting requirements for fire endurance	Equivalence of use of sprinklers and smoke detectors
Requirements for non-combustibility	Use of sprinklers and smoke detectors
Adequate egresses - adequate capacity of egresses	1. Equivalence of size and numbers of egresses 2. Restricting occupancy 3. Restricting density

EXISTING BUILDINGS	PROBLEMS/SOLUTIONS
Enclosures for egress-fire rating	1. Smoke detectors
	2. Sprinklers
	3. Limiting height
	4. Limiting access distance
Light and Ventilation	Equivalent requirements between natural and artificial light and ventilation
Level of compliance required	1. Risk analysis (NFPA/HUD type approach)
	2. Establishment of "factor of safety"

APPENDIX 2

WORKSHEET FORMAT

The following chart is an example (reduced from 30" x 40") of the worksheet format used in team meetings to aid in structuring the team discussions around particular code issues. Team members were asked to fill the worksheets with their perceptions of a particular regulation, which were then discussed in team meetings.

ARTICLES OF THE STATE BLDG. CODE

ARTICLE	PROVISIONS	PROBLEM TYPE	#	USE GROUP	MAGNITUDE
6 MEANS OF EGRESS	609.0 NUMBER OF EXITWAYS	DENSITY & OCCUPANCY LOAD ARE NOT TAKEN INTO ACCOUNT HERE - THIS DOES (SUDDENLY) TAKE CONSTRUCTION TYPE INTO ACCOUNT. NOT REALLY A PROBLEM BUT INCONSISTENT TO SUDDENLY CONSIDER CONSTRUCTION TYPE		DIFFERENT REQUIREMENTS FOR EACH USE TYPE PROBLEMS (CONT'D): ANECDOTAL - RECOGNITION THAT 1A, 1B, 2A, 2B CONSTRUCTION REDUCED HAZARDS ENOUGH TO WARRANT SPECIAL CONDITIONS, HAS NOT YET RECOGNIZED EFFECTS OF SPRINKLERS OR EARLY WARNING.	
IN CONVERTING TO USE TYPES: F1, F2, F3, F4, F5, F6, F7, H1, H2 THIS ARTICLE HAS VERY STRONG IMPACT	TABLE 6-6 & 609.92 MINIMUM STANDARD FOR STAIRWAY & ENCLOSURE CONSTRUCTION	ESTABLISHES RATINGS FOR COMPONENT PARTS BUT DOES NOT ADD IN EARLY WARNING SYSTEM OR SPRINKLERS SUGGEST ADDING NOTE 2 REQUIRING CROSS-COORDINATION WITH 605.32 & 2204, WHICH SHOULD BE REVISED TO ALLOW 1 HR. RATING FOR ENCLOSURES OF EXISTING STAIRS.		PROBLEMS (CONT'D): REPRESENTS COMPILATION OF REQUIREMENTS TRADITIONALLY SPREAD OUT IN SEPARATE SECTIONS - SUFFERS FROM SOME BASIC INCONSISTENCIES & DOES NOT INCORPORATE EFFECT OF SPRINKLERS OR EARLY WARNING	
IN CONVERTING TO USE TYPES: C, E, L1, L2 THIS ARTICLE HAS STRONG IMPACT	616.8 SUPPLEMENTAL STAIRWAYS	REQUIRED ENCLOSURES FOR MONUMENTAL, ORNAMENTAL, ACCESSORY STAIRS: DOES NOT TAKE FIRE SUPPRESSION SYSTEMS INTO ACCOUNT & WILL HAVE BROAD AESTHETIC IMPACT SUGGEST ALLOWING SUCH STAIRS WITHIN ANY BLDG TYPE OR USE GROUP BETWEEN ANY TWO CONNECTING FLOORS, WITHOUT ENCLOSURE.		INDUSTRIAL (D), ASSEMBLY (F), INSTITUTIONAL (H), 3D, 3C, 4A, 4B PROBLEMS (CONT'D): MONUMENTAL STAIRWAYS NOT REQUIRED AS A MEANS OF EGRESS SHOULD BE CONSIDERED ON THE SAME BASIS AS THE LARGE OPEN ATRIUMS NOW USED EXTENSIVELY. SOME RATIONALE FOR INSTITUTIONAL PROHIBITION, OTHERWISE IT APPEARS THERE ARE MANY OPTIONS AVAILABLE THROUGH SPRINKLERS, EARLY WARNING, & COMPARTMENTATION TO MAINTAIN WHAT APPEARS TO BE AN EQUIVALENT RISK.	ENORMOUS MAGNITUDE FOR HISTORIC BLDGS. OR BUILDINGS WITH BIG, BEAUTIFUL STAIRCASES
IN CONVERTING TO USE TYPES: B, D, L3 THIS ARTICLE HAS SLIGHT IMPACT	616.91 STAIRWAY STRENGTH	REQUIRED UNIFORM 100 POUNDS PER SQUARE FOOT LOAD EXCEPT IN RESIDENTIAL WITHOUT REGARD TO OCCUPANCY LOAD OR DENSITY - IS THE REQUIRED 100 P.S.F. LIVE LOAD CAPACITY EXCESSIVE FOR SOME OCCUPANCY TYPES? SUGGEST LOAD CAPACITY OF EXISTING STAIRS BE GRADED BY USE CATEGORY OR DENSITY.		PROBLEMS (CONT'D): REASONABLE STATISTICAL ASSUMPTION - AT SOME TIME OF EMERGENCY EGRESS THE STAIRWAY WILL BE FILLED TO CAPACITY - THEREFORE 100 PSF NOT UNREASONABLE	
IN CONVERTING TO USE TYPE: A THIS ARTICLE HAS NO IMPACT	605.32 EXISTING EXITWAYS	SUGGEST REDUCTION OF EXIT WAY SIDE ENCLOSURE RATING TO ONE HOUR IF SUITABLY SPRINKLERED; ALSO SUGGEST CLARIFICATION OF RATING REQUIRED FOR NON-EXITWAY SIDE (PREFERABLY ONE HOUR) CAN CRITERIA BE FORMULATED FOR VARIANCES CONCERNING RETENTION OF ORIGINAL FINISH MATERIALS IN EXITWAYS WHICH MAY NOT PROVIDE PROPER RATING?		PROBLEMS (CONT'D): A-245 SECTION COUPLES WITH TABLE 3-5 FOR WHAT WOULD BE REQUIRED IN A NEW BUILDING IF IT EXCEEDED 3 STORIES OR 40FT. IN HEIGHT. THUS, IT WOULD HAVE TO BE AT LEAST 3C CONSTRUCTION (TABLE 3-4) & THEREFORE EXITWAYS (STAIRWAYS) WOULD HAVE TO BE ENCLOSED IN A 2HR. FIRE RATED ENCLOSURE. B THE REQUIREMENTS FOR NUMBERS OF OCCUPANTS ARE TOTALLY ARBITRARY & UNRELATED TO ANY RATIONAL APPROACH	
	605.37	SUGGEST ADDING CONNECTING BALCONIES			

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BIBLIOGRAPHY

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15. SUPPLEMENTARY NOTES This report presents the results of a contract study covering technical barriers to the re-use of existing buildings with particular regard to the impact of building regulations. Any conclusions, opinions, or interpretations contained herein are the responsibility of the author's of this report.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This team investigation focuses on provisions of the regulatory systems which adversely impact re-use of existing buildings. The findings are separated into experientially based team analyses of regulatory systems and data gathered from several Massachusetts sources. A series of recommendations for resolution of specific code problems are made, and a research agenda is presented to identify areas for future study towards the resolution of code-rehab conflicts.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Building codes; building research; code enforcement; construction; existing buildings; rehabilitation; renovation

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